

Department of Energy (DOE)

Technology-Supported Learning Business Case



April 1997

U. S. DEPARTMENT OF ENERGY

Assistant Secretary for Human Resources and Administration
Office of Training and Human Resource Development
and
Office of Information Management

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Preface

This business case was produced with input from, and in consideration of, the entire DOE-wide complex, which includes Headquarters, Field Organizations, and Laboratories.

The information presented in this business case is based on data obtained during the summer of 1996. Therefore, the business case may not reflect the most current state of Departmental education and training activities and advanced training technologies. To maintain currency, yearly reviews and revisions to the business case are recommended.

The feasibility and effectiveness of a corporate approach to education and training was explored in this business case. The concept of a corporate approach implies a common service or support to one or more business line(s) across the Department.

The term "technology-supported learning" was selected to indicate the use of various types of technology to deliver education and training. Other terms such as distance education, distance learning, and technology-based learning are regarded as synonymous.

A 5-year lifecycle (fiscal years 1998 through 2002) was assumed for the initial Departmentwide implementation of technology-supported learning. Technology acquisitions for fiscal year 1997 (Year 0) are provided for informational purposes only; they are not included in the analysis of benefits and costs.

Questions and comments about this business case should be addressed to the Department of Energy, Assistant Secretary for Human Resources and Administration, Office of Training and Human Resource Development, or Office of Information Management, Washington, D.C. 20585.

Abstract

This business case was developed to determine the economic feasibility and effectiveness of delivering cross-cutting training and education courses electronically, using advanced training technologies. The status quo, a non-corporate approach to training (85 percent traditional classroom; 15 percent electronic delivery via advanced training technologies) was compared with a corporate approach to delivering cross-cutting training and education courses using various technological alternatives. Four alternatives were analyzed to determine benefits, costs, and return on investment data over a 5-year period. The analysis of benefits and costs corroborated the Department of Energy's Strategic Implementation Plan 44, which calls for a corporate approach to training. Analysis also resulted in several recommendations: (1) develop a corporate approach to technology-supported learning, (2) adopt a multi-technology solution for delivery of cross-cutting education and training, and (3) establish and cultivate needed resources.

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EXECUTIVE SUMMARY

A business case is typically developed to identify the most desirable investment solution for a business need.

This business case was developed to examine whether or not it would be economically feasible and cost effective for the Department of Energy to establish and invest in a corporate technology-supported learning program; a program that would provide for the delivery of cross-cutting education and training activities via advanced training technologies such as: interactive television (ITV), multimedia (MM), computer-based training (CBT), and Internet and web-based training. The use of technology-supported learning is expected to gradually increase over the next 5 years as overall awareness of the potential cost-effectiveness of technology-supported learning increases.

Initially, the business case development effort was undertaken by the Training and Information Management communities of interest in response to budget cuts and strategic alignment implementation plans that called for a corporate approach to training, integration of information management, and reduced travel. Later, it was learned that the business case also begins to satisfy Congressional mandates in the Information Technology Management Reform Act (ITMRA), enacted in 1996.

The business case was designed to require development of a Departmental baseline (status quo), performance of a needs assessment and gap analysis, selection of proposed alternative solutions, analysis of the benefits and costs of each alternative, comparison of return on investment data, and development of recommendations. Departmentwide representatives from Headquarters, Field Organizations, and Laboratories provided developmental data through a structured set of strategic information management (SIM) workshops, and through surveys, questionnaires, telephone contacts, and various data analyses and review efforts.

The baseline effort confirmed that the Department is currently using a non-corporate approach to education and training. A non-corporate approach is one in which organizations make independent decisions about education and training development, delivery, and funding for their personnel. The baseline effort confirmed that 85 percent of the education and training in the Department (Federal and contractor) is currently delivered in traditional settings such as the classroom with the remaining 15 percent being delivered via advanced training technologies. By establishing an education and training baseline, the Department is well-positioned to begin performance measurement activities (e.g., measure cost savings, successes, benefits).

Through a needs assessment effort both current and future education and training needs were identified for Departmentwide customers. A gap analysis indicated that many education and training activities have cross-cutting applicability and would be appropriate for delivery using advanced training technologies. An analysis of industry best practices in technology-supported learning activities was performed to identify the advanced training technologies that would be viable for the DOE. Organizations that would be appropriate for benchmarking the DOE were also identified. The needs assessment and best practices data were considered in the development

of business case alternatives and in the assumptions made in the analysis of benefits and costs. The industry best practices and benchmarking data also position the Department for future benchmarking efforts.

Two scenarios were considered for using technology-supported learning within the DOE. One scenario involves establishing a corporate approach for expanding the Department's existing technology-supported learning capabilities and for converting traditional lecture-based and self-study courses and materials into advanced training technology formats. The other scenario involves the continuation of the current non-corporate approach where organizational elements within the Department deliver education and training activities without the benefit of a corporate approach to technology-supported learning.

Within the corporate approach scenario four alternatives were developed and analyzed. The four corporate approach alternatives use different mixes of advanced training technologies. The non-corporate approach scenario has one alternative representing continuation of the Department's status quo. The analysis of benefits and costs indicated that each of the alternatives in the corporate approach scenario resulted in a return on investment from \$60 million to \$66 million, while the return on investment for the non-corporate approach scenario was \$2 million.

The business case recommendations are the result of extensive research, data collection, and analysis. They position the Department to take full advantage of available resources and emerging technologies as they evolve. The following high-level recommendations are presented in this business case:

1. **Adopt a corporate approach to technology-supported learning** . A corporate approach versus a non-corporate approach (status quo) will produce 33 times greater net savings (\$66 million as opposed to \$2 million). A corporate approach will improve learning effectiveness; on-the-job performance; and the quality, standardization, and consistency of training; and increase the overall system efficiency through reduced redundancies and decreased learning time.
2. **Adopt a Multi-Technology Solution** , which will use a mix of existing technologies across the Department; i.e., interactive television (ITV), multimedia/computer-based training (MM/CBT), and high speed networks/Internet. The Department should build on these technologies over the next 5 years, integrating new technologies as they evolve. A \$36.5 million investment over a 5-year period will provide for a \$10 million capital equipment investment and a \$26.5 million operating budget investment that includes course conversion and delivery costs.
3. **Establish and cultivate needed resources** to include external and internal partnering agreements, establishment of centers of excellence, in-house course conversion capabilities, and an approved list of vendor products and services.

The implementation of the business case recommendations will result in a \$66 million return on investment over 5 years. The payback point will occur early in the second year. The

recommendations will enable the Department to achieve its ultimate goal of delivering just-in-time training to all Federal and contractor employees at their individual workstations.

The business case addresses what needs to be done to deliver cross-cutting education and training in a cost-effective and efficient manner using advanced training technologies. The business case results and recommendations will be presented to Training and Information Management executives for approval and funding. A project plan and the implementation of technology-supported learning are dependent upon funding.

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1. Background

This section describes the guiding principles and associated activities that lead to development of the Departmentwide business case for technology-supported learning.

1.1 Guiding Principles

On May 3, 1995, the Secretary of Energy issued a report entitled “Saving Dollars and Making Sense.” In response to the report, in August 1995, Strategic Alignment Implementation (SAI) Plans were issued to reduce travel (SAI 36), integrate information management (SAI 39), and develop a corporate approach to training (SAI 44). These plans prompted customer calls for help in implementing technology-supported learning from a number of Department of Energy (DOE) organizations.

In addition, the Information Technology Management Reform Act (ITMRA) was introduced in 1995 and enacted by Congress in 1996 “to facilitate, encourage and provide for efficient and effective acquisition and use of modern information technology by executive agencies”; and “to increase the responsibility and public accountability of the heads of the departments and agencies of the Federal Government for achieving substantial improvements in the delivery of services to the public and in other program activities through the use of modern information technology in support of agency mission; and for other purposes.”

1.2 Strategy

Based on the guiding principles above, and the fact that advanced training technologies are rapidly maturing, the Office of Training and Human Resource Development and the Office of Information Management partnered to establish an information sharing forum for all Departmental elements with interest in technology-supported learning. Representatives from DOE administrative and program offices and laboratories, other Federal agencies, educational institutions, and the private sector, participated in four video teleconferences between June and October 1995. This partnering effort produced a Departmentwide vision, mission statement, and goals for technology-supported learning. These products were used to formulate Departmental strategy in the form of an action plan (appendix A). The vision, mission, goals, and the action plan critical milestones are provided in the following sections.

1.2.1 Vision

Learning needs in the Department of Energy will be effectively met through a mix of traditional instructional methods and the use of compatible technology-supported learning tools, which will continually improve learning effectiveness.

1.2.2 Mission

Systematically identify the Department's learning needs and, where technology-supported learning is determined to be the medium, facilitate the identification and development of technology-supported learning-based solutions and instructional methods.

1.2.3 Goals

The first eight goals were developed by participants in the four video teleconferences. Three additional goals were developed by workshop participants directly involved in the development of the business case. Goals 1, 2, 4, and 8 were addressed during the research and development of the business case. Goals 3, and 5 through 11 involve issues that will be addressed during implementation planning and execution.

1. Identify equipment, technology, and other resource requirements and baselines for the effective implementation of technology-supported learning.
2. Evaluate the readiness of the Department and the policies and standards required to optimally harness technology-supported learning.
3. Identify instructional strategies and methods that will improve the quality and effectiveness of technology-supported learning activities.
4. Identify Federal and contractor learning activities that have cross-cutting applicability that would make them candidates for implementation via technology-supported learning approaches.
5. Develop standards for technology-supported learning format, structure, and process that will promote uniformity, reduce duplication of effort, and improve usefulness.
6. Identify evaluation criteria and parameters to measure the instructional effectiveness and cost savings associated with technology-supported learning as an alternative to conventional learning activity delivery.
7. Conduct pilots to validate system readiness, demonstrate the effectiveness of technology in improving learning outcomes, and evaluate cost versus performance.
8. Develop a cooperative relationship with other government agencies, the private sector, universities, laboratories, and other educational institutions involved in technology-supported learning, to share resources, products, and lessons learned.
9. Optimize the use of existing Departmental technology-supported learning facilities and capabilities (e.g., Central Training Academy, Energy Training Center, and contractor facilities).

10. Eliminate redundancies in cross-cutting training and education course development and delivery to reduce costs, increase efficiency, achieve the highest quality courses, and establish Departmentwide consistency.
11. Provide optimal training and educational opportunities throughout the DOE complex to maintain technical competence.

1.2.4 Critical Milestones

The action plan critical milestones for technology-supported learning, with current status, are provided below.

1. **Identify a home.** The Office of Training and Human Resource Development has been identified as the home for technology-supported learning.
2. **Establish a charter.** A draft charter, which proposes creation of a Departmentwide steering committee for technology-supported learning, has been distributed to both the Training and Information Management communities of interest for review and comment.
3. **Institute a partnering agreement.** A draft partnering agreement, which is intended to partner the Training and Information Management communities of interest, has been distributed for review and comment.
4. **Develop a business case.** This product comprises the business case. A business case development effort was needed to determine the feasibility of establishing and investing in a corporate technology-supported learning program. Business case results and recommendations will be reported to various training and information management managers and groups within the organization, up to and including the DOE Training and Development Management Council, and the DOE Executive Committee for Information Management.
5. **Develop a master plan.** A master plan for technology-supported learning will be developed when business case recommendations are approved and resources are allocated.

1.3 Technology-Supported Learning

The following sections provide a definition of technology-supported learning, an overview of major delivery methods currently in use, typical benefits, and some of the advantages and disadvantages of each method.

1.3.1 What is Technology-Supported Learning?

Technology-supported learning is synonymous with the United States Distance Learning Association (USDLA) definition of distance education, which states:

“Distance Education refers to teaching and learning situations in which the instructor and the learner are geographically separated, and therefore, rely on electronic devices and print materials for instructional delivery. Distance Education includes distance teaching--the instructor’s role in the process, and distance learning--the student’s role in the process.”

The term "technology-supported learning" is used in this business case to ensure differentiation from the premise or supposition that “distance education” and “distance learning” are only associated with interactive television (ITV) and transmission via satellite. Technology-supported learning implies various advanced training technologies including ITV, multimedia (MM) and computer-based training (CBT), and Internet and web-based training. These advanced training technologies will be used to aid instructors teaching at a distance (via ITV) or to enable students to learn on their own, at their desktops or in multimedia-equipped (and often Internet-connected) learning centers. While ITV typically allows students to query the instructor directly for help, students learning at their desktop or in a learning center may receive assistance from telephone help lines, online help desks, or live proctors.

1.3.2 Representative Technology-Supported Learning Delivery Methods

Several technology-supported learning delivery methods are fully mature, widely accepted, and extensively used by all branches of the military, numerous Federal agencies, many fortune 500 companies, and by an increasing number of educational and vocational training institutions. The following sections provide brief overviews of the current types of technology-supported learning delivery methods, their primary technology features, and some high-level advantages and disadvantages associated with each method. Some common training technologies (e.g., audio teleconferencing and instructor-led videodisc and CD-ROM-based presentations) have been omitted because of their similarity to those being presented. Many new technologies that are not described below are currently being field tested and will be emerging for wide-spread use within the next few years.

1.3.2.1 Interactive Television

Interactive television is a very common technology-supported learning delivery method. With this delivery method, the instructor and the student are physically separated, but connected through video, audio, and sometimes data links. The use of ITV provides opportunities to acquire custom-converted or re-purposed (modified) training from vendors. It also provides wide-area telemeeting capabilities with participant voting abilities, and allows multi-site, real-time project/program coordination and evaluation. The following are examples of ITV configurations.

Two-way video, two-way audio (terrestrial and satellite). This type of ITV utilizes video and audio links that connect the instructor to one or more student location(s) through video teleconferencing equipment.

Terrestrial. Commercially available video teleconferencing units use terrestrial lines (e.g., ISDN, T1, FTS 2000-SCVTS, FTS 2000-CVTS) for the delivery of instruction. DOE sites already utilize this type of technology for video teleconferencing.

Advantages of this type of ITV include lower initial costs than satellite transmission and quick set-up of the equipment for learning activities. Disadvantages are somewhat poorer video quality than is possible with satellites, a limited number of students can be connected in a session, special telephone lines must be installed to achieve limited video quality, and the high cost of using terrestrial lines for lengthy learning activities.

Satellite. Commercially available two-way video, two-way audio, is possible via satellite. This transmission method requires an expensive, uplink capability at each participating site. It is, therefore, not widely used for training applications.

One-way video, two-way audio (satellite and terrestrial). Currently, this is the most commonly utilized type of ITV. It incorporates the satellite delivery of live audio and video input from the uplink studio, usually showing an instructor, a panel of experts, still graphical images and/or pre-taped video segments. Students interact with the instructor in real-time via common telephone lines. This is the method used by the Office of Nonproliferation and National Security, Central Training Academy in Albuquerque, New Mexico.

An advantage of this type of ITV is that the satellite transmissions can reach all DOE downlink sites using one satellite broadcast. This is a more cost-effective method of delivery when needed for a large audience spread across the nation. In addition, the video and audio are of higher quality than that found in terrestrial-based video teleconferencing.

A disadvantage of this type of ITV is that it may not be cost-effective for teaching small numbers of students, even after installation costs have been expended. This is due to the current high costs for producing courses and procuring satellite time. Training a small number of students could be cost-effective or at least justifiable if the urgency of a course were great or if travel expenses for either the instructor(s) or students were found to be greater than the operational costs.

One-way video, two-way audio with data link (satellite and terrestrial). This format is the same as one-way video, two-way audio described above, except that a data link (e.g., X.25) is added. This link enables real-time testing and monitoring of student understanding by the instructor. Students use a response pad to key-in answers to questions or to signal the instructor that they wish to speak or need help. The instructor has a special monitor that summarizes response data or cues the instructor on who needs help or wishes to speak.

One-way video, one-way audio (satellite). This format is used by many universities to broadcast courses. Examples are the National Technological University (NTU) and the Mind Extension University (ME/U). Often the training or educational institution provides video taped courses for delayed distribution. Instructional materials are distributed by facsimile, U.S. mail, overnight delivery, world-wide web downloads or electronic mail. Learning activity facilitators may be required at each receiving site to assist in distributing material and proctoring exams. Student-instructor interaction does not occur during the instructional process, but is after-the-fact (often through the use of phone calls or fax messages. Therefore, the instructor cannot as quickly monitor and adjust the instruction to clarify concepts and follow student interests.

Some of the advantages of this format are relatively low costs for the delivery of learning activity content and the fact that consistent information is delivered to all sites. Disadvantages include the impersonal nature of the instruction and the lack of real-time interactivity between the instructor and student, which can increase the potential for misunderstandings. Learning activities that require students to perform complicated tasks that could be clarified through interactivity during the instructional process cannot be delivered via this type of ITV.

1.3.2.2 Multimedia/Computer-Based Training

Multimedia and computer-based training (CBT) are technology-supported learning delivery methods in which the student's primary learning tool is a personal computer. The computer is located either at the desktop or, more commonly, at a properly equipped learning center. The learning activity content is typically created by an instructional designer, stored on a compact disc-read only memory (CD-ROM) or laserdisc, and delivered via the personal computer. The computer typically controls the pace and direction of the instructional process, often utilizing sophisticated instructional algorithms to sequence and provide presentations for the learning activity. The student is able to receive the specific training that he/she needs, when and where it is needed. Multimedia/CBT learning activities range in complexity from simple self-guided slide shows to life-like simulations. Costs vary with complexity.

The main advantage of this delivery method is that it best facilitates "just-in-time training" or "learning on demand." This technology also allows a site to customize courseware to meet site-specific personnel needs. The primary disadvantage of multimedia and CBT is the lack of interaction with a live instructor, though this disadvantage is often compensated for by careful instructional design that anticipates student questions and has pre-stored answers, the presence of a live proctor in the learning center, or by having a help line or an electronically accessible help desk.

The following sections briefly identify the main categories of multimedia/CBT along with a typical application for each category. Successful implementations have shown very high learning and course compression rates. These advanced types have typically been very expensive to develop and deliver, but as with simulations, they have their place when safety, health, and other conditions justify their use. The most advanced types of CBT, such as intelligent tutoring systems and virtual reality training, are not described here, but they are being used in special situations.

Slide Shows and Linear Computer-Based Training. This is a low-end (in terms of complexity and cost) delivery system of learning activity information. The computer is, quite simply, a page turner that presents instruction in a sequential fashion. After the student reads/views one screen of information he/she pushes a key and progresses to the next screen in sequence. The instructional process may include interspersed quiz or exam questions with answer recording and processing. The instruction may include a final exam. However, the student's understanding is not evaluated by the computer during the process of learning and no instructional delivery decisions are made related to the student's level of understanding.

Drill and Practice. This involves the repeated presentation of questions or scenarios in a topical area. The student practices the application of knowledge previously learned. It is particularly useful for teaching factual information. It may be an integral part of a more complex learning activity or may be used by the student prior to taking an exam. This method is also low-end in terms of complexity and cost.

Learner-Selected Branching. This form of CBT offers the student some options with respect to which part(s) of the learning activity to take, as well as flexibility in sequencing. This form enables the student to "zero-in" on unfamiliar aspects of the learning activity and, if desired, skip the sections that are known. This may be used as a more time-efficient way to conduct refresher training. It is much more complex and costly than straight slide-show/linear CBT.

Canned Simulations. This form of CBT usually involves a film clip or animation of a process or procedure that the student is expected to learn. It may be integrated into a larger learning activity involving any of the above styles. It is more costly due to the need for producing graphics (video, stills, or animation) in addition to audio or text. The students can practice performing some procedure or observing some process, but typically must conform to the pre-programmed sequence. There is very little built-in intelligence in the courseware.

Fully Interactive Simulations. This form of CBT has a high degree of complexity and cost. It involves context-sensitive student interactivity and involvement in the simulation being presented. It can be useful for demonstrating complex tasks and processes that might otherwise put the student at a safety risk. If the student chooses an incorrect option, the simulation re-presents the key points, often in a different way. The interactive simulation protects the student from injury or embarrassment, while allowing him/her to learn the correct or responsible actions. Often using high quality, computer-generated graphics coupled with realistic audio, this type of simulation can have a video-game-like feel, which may be described as a limited application of virtual-reality technology. Such complex simulations approach the effectiveness of on-the-job training in a mock-up environment. Extensive knowledge of the system must be modeled and programmed into the courseware.

1.3.2.3 Internet/Intranet-Based Training

These delivery methods are virtually identical to the multimedia/CBT methods with one exception: high-speed networks allow training to be delivered to and used by students who are geographically distant from the computer that holds and controls the instructional program. The instructional program is delivered to a student's computer over the network to which a student's computer is connected (local or wide area network, dial-up connection to the Internet, or a local intranet). The instructional program and any required support files are transmitted over the network and displayed on the student's computer, which uses a special multimedia player or a World Wide Web browser, such as Netscape Navigator. The Internet can also be used to support traditional training delivery methods by providing for downloadable course outlines, lecture notes and slides, reading materials, supplemental media clips, private electronic mail-based answers to questions, and online group discussions.

The most significant advantages that network-delivered training have over multimedia/CBT are the low-cost of getting the courseware to the students and the improved ability to maintain configuration control throughout the system as updates are made to the learning activities. The widespread use of the Internet will also enable centralized coordination of Departmental course catalogs, learning activity registration, and access to other global information.

Currently, Internet bandwidth limitations prevent wide-spread use of media-intensive content, as a few seconds of high fidelity video or audio can require several megabytes of data to be transferred from the host to the student's computer. Many Internet training applications are using locally stored media content (on CD-ROMs) to augment Web-based training interactions.

1.3.3 Benefits of Using Technology-Supported Learning Delivery Methods

The use of technology-supported learning, which incorporates the advanced training technologies described in section 1.3.2, as well as other newly emerging technologies, offers the Department of Energy many potential benefits that have been extensively documented. The following is an excerpt from an article by Larry D. Moulds, Ph.D., entitled "Using Distance Learning in the Training of Adult Learners" published in the United States Distance Learning Association publication *ED Journal*, Volume 10#6, June 1996.

"Technology-based interactive learning has the following potential benefits (Dennis, 1994; Kearsley, 1990; Wilson, 1991):

1. Reduced learning time - typically 30-40% less time is required compared to classroom instruction.
2. On-demand learning - instruction is available when and where the learner needs it. No need to wait for or travel to a scheduled class. Increases access to learning for the disabled.
3. Increased motivation - students usually report that they find technology-based interactive learning more interesting and enjoyable than classroom lectures.
4. Increased achievement - when corrective feedback or a mastery learning strategy is provided, students often show better test results, retention, or job performance from technology-based interactive learning.
5. Better quality control - since learning experiences are delivered in the same way each time, [they] are much more consistent and reliable than classroom instruction.
6. Increased safety - learners can learn about and practice dangerous procedures without a safety concern.
7. Greater flexibility - fluctuations in the number of learners or their backgrounds can be accommodated more easily than with classroom instruction.

8. Improved accountability - automatic collection of data on learner performance can verify learning accomplished and identify learning problems.
9. Faster revision - to the extent that the learning experiences are delivered via a networked system, changes and updates to information can be made immediately.
10. Reduced delivery costs - once developed, technology-based interactive learning is likely to cost less relative to labor intensive classroom instruction. It can also be used instead of expensive equipment.
11. Learner controlled - each learner is able to review topics or to skip beyond the information they already know."

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2. Introduction

A business case is typically developed to identify the most desirable investment solution to a business need. Projected benefits and costs are determined for each viable solution. Analyses of the benefits and costs are conducted to predict each solution's investment payback point and return on investment data. The results of the analyses are used to compare the proposed solution(s) with the status quo. The results of a business case will validate whether or not it is cost effective to proceed with the investment.

The technology-supported learning business case development process included the: collection and analysis of baseline data, performance of a needs assessment, review of industry best practices, development of alternative solutions to satisfy the gap between the baseline data and the results of the needs assessment, and an analysis of the benefits and costs of each alternative to determine the most cost-effective solution.

The technology-supported learning business case may lead to establishment of a corporate technology-supported learning program. While the facts and figures of this business case support the concept of a corporate program, next steps (i.e., development of a comprehensive program plan and implementation plan) are dependent upon: (1) approval of the business case recommendations by both the Training and Development Management Council and the Executive Committee for Information Management, and (2) appropriate Congressional/DOE corporate funding.

2.1 Purpose

This *DOE Technology-Supported Learning Business Case* was developed to examine and determine whether or not it would be economically feasible and cost effective to establish and invest in a corporate technology-supported learning program. Such a program would provide for the delivery and receipt of cross-cutting education and training courses via the use of advanced training technologies (i.e., interactive television, computer-based training, multimedia, high-speed networks, and other technologies, as they evolve).

The business case satisfies critical milestone 4 in the action plan (appendix A) entitled "DOE Approach to Distance Learning," which was issued March 27, 1996. The action plan and critical milestones were developed in response to budget cuts and the Secretary of Energy's Strategic Alignment Implementation (SAI) Plans. The SAI plans called for development of a corporate approach to training, integration of information management, and reduced travel. The action plan officially partnered the Training and Information Management communities of interest, and marked the beginning of a collaborative effort with DOE-wide elements to support the SAI plans. It is through such partnering and collaboration that a unified Departmental direction will be ensured for the effective application of advanced training technologies in education and training.

The business case also begins to address and satisfy the Congressional mandates of the Information Technology Management Reform Act of 1996, which requires performance-based and results-based management.

2.2 Project Scope

The initial scope of the business case included all education and training activity. A baseline (“as-is”) was developed to describe the current state of education and training for the DOE-wide complex. The entire breadth of courseware development, delivery, and receipt of education and training courses was examined for both Federal and contractor employees. Following establishment of the baseline, the scope of the business case project was narrowed to focus on the creation, delivery, and receipt of cross-cutting education and training courses, particularly suited to delivery via advanced training technologies. This change in scope was agreed by the business case workshop participants to ensure project manageability and responsive development of the business case.

2.3 Participation

All DOE Headquarters and field elements were invited to participate in the development of the *DOE Technology-Supported Learning Business Case*. A cross-functional group of subject matter experts, both Federal and contractor representatives, was established from the Training and Information Management communities. These representatives attended workshops, gathered data from their sites, and provided input as needed to satisfy the objectives of the business case. The Departmental elements that did not send participants to the workshops were invited to submit verbal or written input to the business case, and input received was incorporated.

A core planning team of subject matter experts was formed out of the larger cross-functional group to design the business case project approach, manage the project processes, design and facilitate the workshops, document and analyze workshop results, and produce the business case product. In addition to designing, developing and facilitating formal workshops, the core planning team members participated in face-to-face meetings, weekly telephone conferences, and video teleconferences as needed to report project status and to accomplish tasks.

A total of 38 DOE organizational elements provided input to the business case. Of that number, 16 elements sent representatives to at least one of the three workshops. Additional information about participants is provided in chapter 3. A list of the organizational elements represented at the workshops, and the names and addresses of the workshop participants are provided in appendix B.

2.4 Methodology--Strategic Information Management

The approach used to develop the business case followed a modified version of the Strategic Information Management (SIM) framework and process, established by the General Accounting

Office (GAO), and published in the GAO document, *Executive Guide - Improving Mission Performance Through Strategic Information Management and Technology* (May 1994).

SIM has been used for at least nine Federal Government strategic information management initiatives, including projects conducted by the United States Coast Guard, Department of Commerce, and the Social Security Administration. Leading private sector organizations employing the SIM process include Kodak, Xerox, and American Airlines. California, Florida, and Texas are among the state governments implementing SIM processes.

The use of strategic information management practices is cited in several Congressional mandates including the National Performance Review (NPR), the Chief Financial Officer (CFO) Act, the Government Performance and Results Act (GPRA), and the Information Technology Management Reform Act (ITMRA).

The Department of Energy has successfully completed a SIM project for the Office of the Assistant Secretary for Human Resources and Administration. Based on the results of the project, a Corporate Human Resources Information System (CHRIS) is being developed for DOE-wide implementation.

The SIM framework provides a methodology for developing an infrastructure and set of management processes that ensure the strategic alignment of existing and proposed business solutions with the Department's mission and goals. The process typically involves defining a mission based on customer requirements and needs; establishing core processes that accomplish the mission; understanding the key decisions that guide mission delivery processes; supporting those decisions with the right information available to the right people at the right time; and using technology to collect, process, and disseminate information in ways that improve the delivery of products, goods, and services to customers.

The SIM process used to collect the information for the technology-supported learning business case was dynamic in nature. Three groupware-supported, facilitated workshops were held to collect information for the development of the business case. The design and flow of the workshops were evaluated and, at times, were altered based on participant feedback anonymously received via daily evaluations. The workshop results were also evaluated to ensure there were no major gaps in the information collected. Questionnaires and telephone interviews were used to collect information from the DOE elements that were not able to send a representative to the workshops.

In addition to the three workshops, analyses were conducted to determine industry's current best practices in technology-supported learning and to develop an inventory of the information systems being used to support DOE education and training processes. Other organizations that had implemented technology-supported learning were contacted to determine advantages, disadvantages, and lessons learned. These data provided the basis for developing a future scenario for technology-supported learning for the DOE. The inventory of information systems provides an understanding of the information that is needed and is a starting point for future

consolidation of redundant systems. The inventory also provides opportunities for expanding existing data bases and improving user access to information.

2.5 Business Case Development Tasks

The following is a synopsis of the tasks required for the development of the *DOE Technology-Supported Learning Business Case*.

Project Planning. This task consisted of developing the project scope and schedules, identifying complex-wide representatives, assigning responsibilities, and scheduling facilities and groupware.

Kickoff Meeting and "As-Is" (Baseline) Analysis Workshop. The focus of the Kickoff Meeting was to achieve a common understanding of the SIM process and how the process related to development of a business case.

The "As-Is" Workshop was used to collect data, determine the baseline of current education and training activities, identify the existing information systems and technology infrastructure available to support cross-cutting education and training, and document the baseline business processes so that performance may be measured in the future. The baseline includes a description of the baseline data collection effort, a summary of the data collected, and the education and training delivery methods currently used within the Department. The baseline data (chapter 3) will be used to develop and measure future performance levels (e.g., cost savings, successes, benefits, service levels, and limitations).

Best Practices and Benchmarking Analysis. Technology-supported learning best practices were identified in other federal government agencies and the private and public sectors (section 4.3). Information was obtained and analyzed for organizations with similar programs, and/or education and training needs. In particular, this research focused on lessons learned and solutions that were implemented. Data gathered through this task and research information previously gathered were used in formulating the business case alternatives and recommendations. Full-scale benchmarking is planned as a future project (section 4.2).

Information Systems Inventory and Assessment. Through this task, the information systems currently used by DOE elements to support education and training processes were identified, points of contact for the systems were established, the types of information that the systems provide were identified, and the systems were categorized by whether they are Departmentwide or local systems. A matrix of the information systems inventory was developed and will be used to reduce redundancies and identify information systems needed to satisfy customer service requirements (appendix D).

To-Be Analysis Workshop and Needs Assessment. Participants were asked to describe what the future use of technology-supported learning within DOE might look like, as a means of developing a "to-be" scenario. A needs assessment was performed, using course descriptions extracted from existing course catalogs. Given a representative sample of cross-cutting courses, the Distance Learning Appropriateness Screening Tool (appendix E) was used to determine which

advanced training technology would be most appropriate for delivery of various cross-cutting education and training courses. Through this effort the anticipated direction of Departmentwide cross-cutting education and training was developed for fiscal years 1998-2002 (chapter 4).

Gap Analysis Workshop. An analysis of baseline and needs assessment data was conducted to determine the technological and organizational changes that the Department must implement in order to satisfy current and future education and training needs and to achieve all or part of the "to-be" envisioned scenario. Analysis determined the gap between the technology-supported learning requirements and the technology-supported learning currently available for education and training. As a result of the analysis, five alternative solutions were developed for satisfying the cross-cutting education and training needs (chapter 5). The alternatives were used to compare the benefits and costs of various combinations of traditional and technology-supported learning delivery methods.

Analysis of Benefits and Costs. An analysis of benefits and costs was the systematic method used to compare alternative solutions. The results of the analysis of benefits and costs were used to predict the payback point and return on investment data for each alternative, and to determine the recommended solution for the corporate approach to technology-supported learning (chapter 6).

Business Case/Executive Presentation Preparation. The results of all tasks were synthesized into the *DOE Technology-Supported Learning Business Case*. An executive-level presentation using the Boylan Method was developed. The presentation will be used to brief the results and recommendations of the business case to both the Training and Information Management communities of interest, up to and including the Training Development and Management Council (TDMC) and the Executive Committee for Information Management (ECIM).

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3. Baseline

The baseline is a time-sensitive snapshot of the current education and training courses, and the advanced training technologies, communication infrastructure, and partnering arrangements used to support and deliver courses within the DOE complex. The baseline was produced to set a point of reference for comparing current and future needs and for measuring on-going progress and program accomplishments.

3.1 Data Collection

The collection of the DOE-wide baseline data was the focus of the As-Is Workshop (the first business case workshop) held in June 1996. At that time, it was difficult to determine just what information would be needed for development of the business case. Therefore, the DOE “universe” (described in section 3.2) was identified as the scope of the baseline and as much data as possible was gathered. The universe included the following types of information.

- Education and training attendance, travel, and related cost data for Federal and contractor personnel throughout the DOE complex.
- Communication infrastructure including information on satellite uplink and downlink facilities, terrestrial-based transmit and receive capabilities, and multimedia-equipped computer workstations.
- Current education and training delivery methods including percentages of courses being delivered via interactive television; desktop video; multimedia/computer-based training; network-based training; and traditional methods such as instructor-led classroom training, on-the-job-training, and correspondence courses.
- Existing arrangements with educational institutions to provide education and training opportunities to DOE-wide Federal and contractor personnel.

The scope and nature of the baseline data collection process necessitated input from more than one source within each DOE element. An attempt was made to collect information management and training data for both Federal and contractor personnel at each site. Several data collection tools were used: gathering input directly from workshop participants, distributing follow-up written surveys, and conducting telephone interviews.

Data collection efforts confirmed early indications that comprehensive Departmentwide data was not available on operating expenses for education and training. Federal and contractor organizations currently use different methods and criteria for collecting and tracking operating expenses. These differences resulted in the available data having no common basis for consolidation or comparison.

3.2 Response Rate

DOE employee population data obtained in the summer of 1996, from the Office of Organization and Management and the Office of Worker Transition, indicated that 131 elements comprised the DOE complex. These elements included 28 Headquarters-based organizations, 76 field organizations, and 27 laboratories. Approximately 18,000 Federal personnel and 113,300 contractor personnel were employed throughout the complex. Appendix C, table C-2 includes a list of all organizational elements and employee populations that comprise the DOE complex.

Data collection efforts for the baseline focused on the 61 DOE elements with a population of at least 50 Federal or contractor employees. If data was received from smaller elements, the information was incorporated into the baseline. Of the 61 elements identified with populations of at least 50 employees, 38 elements (representing 62 percent of the target population) provided some type of input to the baseline data. The organizational elements that provided input to the baseline data are listed in appendix C, table C-1.

3.3 Summary of Results

The following sections provide a summary of the baseline data that was used in both the development of the business case alternatives and the analysis of benefits and costs. Due to the widely varying formats and levels of detail in which the data was provided, analysis was limited to the following areas: attendance, travel, and related costs; communication infrastructure; current delivery methods; and arrangements with educational institutions.

3.3.1 Attendance, Travel, and Related Costs

While comprehensive Departmentwide data was not available, the following sources were used to determine training attendance, travel, and related costs and to extrapolate for the data that was missing.

- Department Training Information System (DTIS)
- Organizations' annual training reports
- Travel data obtained from the Office of Chief Financial Officer
- Office of Training and Human Resource Development reports

Training records for Federal employees extracted from the DTIS data base and reported by the Office of Training and Human Resource Development indicated that on average, for fiscal year 1995, each Federal employee received 57 hours of training and each contractor employee received 63 hours of training. The weighted average for all DOE employees for fiscal year 1995 was 62 hours of training.

Travel data for fiscal year 1995 was only available for Federal employees. The Office of Chief Financial Officer accounting system showed \$4.23 million recorded for training-related travel. A cross check of travel data with DTIS data to determine where Federal employees worked and where they received training indicated that a much larger amount may have been spent than was

recorded. The available data indicated a downward trend in dollars spent on travel for training. This decrease appears to correspond to the Congressional budget cuts that resulted in a 21-percent reduction in training-related travel from 1994 to 1995.

The attendance, training-related travel and other baseline data formed the basis for many of the assumptions that were made in the analysis of benefits and costs for each business case alternative. Descriptions of the alternatives are provided in chapter 5 and appendix F. The assumptions and a description of the analysis of benefits and costs are provided in chapter 6 and appendix H.

3.3.2 Communication Infrastructure

The baseline data gathered for communication infrastructure was sorted into three categories: terrestrial communication capabilities, multimedia/computer-based capabilities, and satellite capabilities. Analysis of the baseline data indicates a broad range of technological maturity levels and a wide variety of communication capabilities with limited corporate-wide interoperability. A summary of the data received is provided in appendix C, tables C-4, C-5, and C-6.

3.3.3 Current Delivery Methods

Based on the data obtained from existing course catalogs, the Department offers approximately 10,000 education and training courses (many redundant) to its Federal and contractor employees. The information obtained for current delivery methods indicates that about 85 percent of all education and training occurs in traditional settings, such as classrooms or through correspondence courses. Multimedia/computer-based training accounted for approximately 5 percent of the delivery methods; on-the-job training and desktop video each accounted for 3 percent; and interactive television and Internet each accounted for 2 percent. A summary of the data that was received is provided in appendix C, table C-7.

It is estimated that between 500 and 1,200 of the 10,000 courses are cross-cutting (e.g., they are applicable to many, if not all, DOE organizations and employees). Cross-cutting courses are the leading candidates for course conversion and technology-supported learning delivery because they have the greatest potential for reaching the largest numbers of students, and achieving the greatest savings. The larger the savings projection, the greater the justification for investing in course preparation and delivery. Cross-cutting courses are also the leading candidates because they provide the greater potential for improving consistency in content and format as they are taught throughout the Department.

3.3.4 Arrangements With Educational Institutions

At least 28 educational institutions provide education and training opportunities to DOE Federal and contractor personnel. A list of these educational institutions is provided in appendix C, table C-3.

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4. Needs Assessment

The needs assessment process was the focus of the second business case workshop, which was held in July 1996. The needs assessment process involved three activities: (1) the identification of the education and training opportunities available to DOE Federal and contractor personnel, (2) the analysis of current and future Departmental cross-cutting education and training needs, and (3) an investigation of industry best practices in advanced training technologies. The information gathered during the needs assessment process was used to identify the advanced training technologies that would be viable options in the DOE environment to support the delivery of cross-cutting learning activities.

The results of the needs assessment process were used to develop alternatives for meeting the Departmental cross-cutting education and training needs and to select advanced training technologies (i.e., interactive television, multimedia, and Internet) for delivery of the cross-cutting learning activities. Each alternative incorporates a mix of the advanced training technologies into a 5-year plan for developing cross-cutting learning activities and acquiring the necessary technologies to support their delivery. Descriptions of the alternatives are provided in chapter 5.

4.1 Cross-Cutting Opportunities

Existing Departmental course catalog data bases were inspected to obtain information on the quantity and types of courses currently offered and to determine a course's potential for cross-cutting applications. Two primary sources were used to obtain the course data.

- A Defense Program-sponsored catalog, which is a compilation of all existing DOE catalogs and contains over 12,000 course listings (with an estimated 2,000 courses coming from agencies or institutions outside of DOE).
- An archived version of the Training Resources and Data Exchange (TRADE) organization's Training Resources Catalog.

The course listings pulled from these catalogs were sorted into 13 topical areas that had been established for the DOE Universal Catalog. The DOE Universal Catalog is a direct descendent of the TRADE Training Resources Catalog and, although operational, it is currently limited in the number of courses it lists.

A Distance Learning Appropriateness Screening Tool (DLAST) was created and used to identify and categorize current education and training opportunities and to evaluate the potential for establishing cross-cutting learning activities. Courses from each of the 13 areas were selected, creating a representative sample of 164 courses. This number is approximately 10 percent of the total number of cross-cutting courses identified from the original catalog sorts. These 164 courses were rated on their cross-cutting applicability. Approximately 150 were identified as offering a high percentage of cross-cutting potential.

The courses were then evaluated using eight selection criteria to determine the most effective advanced training technology delivery method (i.e., interactive television, multimedia, or Internet) for each course. Selection criteria included items such as stability of the content, level of interactivity required, amount of media required, fidelity requirements of the media, and type of testing needed to assure student comprehension.

The DLAST analysis produced percentage estimates of the overall effectiveness of each delivery medium for each course. The results of the analysis indicated that all three advanced training technology delivery methods were viable options and offered different advantages depending on the learning objectives of each course. Appendix E contains a summary of the DLAST analysis process and the results obtained.

The data obtained from the DLAST analysis was used to guide the selection of the delivery method mix for each of the business case alternatives. For example, the multi-technology solution uses a mix of 30 percent delivery via interactive television, 55 percent via multimedia, and 15 percent via Internet. The delivery method mix is a primary discriminator between the alternatives.

The DLAST served as a useful tool for validating the cross-cutting potential of many current course offerings and for determining the overall viability of the three general types of advanced training technologies initially selected for the Department's approach to technology-supported learning. However, the tool was not intended to be a substitute for the evaluation process that must be performed in accordance with the Systematic Approach to Training when delivery methods are selected for actual cross-cutting courses to be implemented.

4.2 Best Practices and Benchmarking

An analysis of industry best practices in technology-supported learning activities was performed to support the identification of viable advanced training technologies. Organizations that would be appropriate for benchmarking the DOE were also identified. Information was obtained through on-line research, literature searches, and from existing DOE technology-supported learning materials and files.

The analysis provided high-level data on the education and training environments, best practices, and advanced training technologies used by educational institutions, Government agencies, and private sector companies to meet a variety of training needs. Best practices were identified in the following areas:

- Training needs assessment
- Course design/development
- Delivery technology used
- Savings measurement
- Training effectiveness measurement

The analysis of industry best practices was performed as the first step in the full-scale benchmarking process initially planned for the business case. Several Federal agencies and private

sector companies that have successfully implemented some advanced training technologies were identified: Federal Aviation Administration, Social Security Administration, Internal Revenue Service, Hewlett Packard, and Ford Motor Company. Initial contact was made with each organization and data about their technology-supported learning initiatives was obtained. The data was considered in the development of the business case alternatives and in the assumptions made for the analysis of benefits and costs.

While preliminary discussions were held with the Federal agencies that expressed interest in sharing information and exploring partnering agreements, the aggressive delivery schedule for the business case and insufficient project resources prevented in-depth data collection and on-site interviews with the organizations. A future benchmarking process is planned.

4.3 Advanced Training Technologies

The DOE report: *A Study of Advanced Training Technology: Emerging Answers to Tough Questions*, dated March 1, 1995, sponsored by the Office of Training and Human Resource Development, provides an extensive list of advanced training technologies and a summary of their strengths and limitations. The list served as the starting point for the identification of advanced training technologies that were considered for the DOE environment. During the third business case workshop held in August 1996, the technologies were evaluated by workshop participants and interactive television, multimedia, and the Internet/high-speed networks were selected as the most viable options.

The DOE report addresses implementation issues associated with advanced training technologies and offers a wide range of lessons learned by Government agencies, military, industry, and academia. The report provides data on approximately 50 organizations that were surveyed and ranked in their level of maturity using advanced training technologies for the delivery of learning activities. The data contained in the report provided significant input to the business case development process.

The industry best practices analysis and the information provided in the DOE report: *A Study of Advanced Training Technology: Emerging Answers to Tough Questions*, provided significant insight into the benefits and risks associated with technology-supported learning and enabled the identification of viable advanced training technology solutions for the Department. The solutions reflect the current status of existing Departmental technologies that support, or have the capability to support, the delivery of cross-cutting learning activities. The solutions also reflect current Departmental areas of expertise and known plans for technology acquisition and standardization.

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5. Business Case Alternatives

During the business case development effort, two scenarios were considered for using technology-supported learning within the DOE. One scenario involves establishing a corporate approach for expanding the Department's existing technology-supported learning capabilities and for converting traditional lecture-based and self-study courses and materials into advanced training technology formats. The other scenario involves the continuation of the current non-corporate approach where organizational elements within the Department deliver education and training learning activities without the benefit of a corporate approach to technology-supported learning.

The concept of a “corporate approach” to education and training was identified in the Department of Energy's Strategic Alignment Implementation (SAI) Plan 44, Corporate Approach to Training. A corporate approach involves the collaboration of organizations and the sharing of resources across more than one business line in the Department.

The corporate approach to technology-supported learning takes full advantage of the enclaves of expertise that exist throughout the Department (such as the Central Training Academy, Pantex, Hanford, Fernald, Lawrence Livermore Laboratories, Richland, Rocky Flats, Stanford Linear Accelerator Center, and other laboratories and offices) as a basis for establishing Centers of Excellence (or lead sites) for advanced training technologies, and courseware development and delivery. A corporate approach to the implementation of advanced training technologies also acknowledges the Federal Government National Performance Review preference for programs that integrate advanced training technologies to improve Departmentwide productivity.

A non-corporate approach to education and training is one in which organizations make independent decisions for education and training development, delivery, and funding for their personnel without taking full advantage or consideration of programs, curricula, courses, and resources available from other organizations within the Department. In a non-corporate environment each organization is acting independently with minimal sharing of resources and information. Some of the consequences of a non-corporate approach include:

- Duplicate courses being developed and offered throughout the Department
- Inconsistent course content and learning objectives
- Inefficient use of technology, resources, and skills
- No common data base for information sharing

Originally, three corporate approach alternatives (A, B, and C) were developed to examine the relative benefits associated with different mixes of the technology-supported learning delivery methods. Each of these alternatives provided a delivery method mix that maximized one of the advanced training technologies; A focused on interactive television, B on multimedia, and C on the use of the Internet and high-speed networks. The descriptions of alternatives A, B, and C are provided in appendix F.

The Multi-Technology Solution (alternative D) represents a synthesis of the best features of alternatives A, B, and C. Alternative D optimizes the use of existing and projected investments in interactive television, multimedia, and the Internet rather than maximizing one delivery method. The description of the Multi-Technology Solution is provided in section 5.4.

Alternative E was developed to represent the continuation of the status quo. This alternative depicts the continuation of the Department's non-corporate approach to delivering education and training activities. The description of the Non-Corporate Approach is provided in section 5.5.

There is rarely just one way to attain a set of goals. The alternatives developed for this business case represent some of the most viable options known to date for achieving the Department's technology-supported learning goals. Many variations of the selected options are possible. As advanced training technologies evolve and Departmental technology resources change, different options, or variations, may emerge as being more practical and appropriate for the DOE environment.

5.1 Assumptions for Alternative Development

In preparing for the development of the alternatives, the following assumptions were made about the Federal and contractor facilities and personnel that comprise the DOE complex, and the acquisition and maturity of advanced training technologies during the 5-year period from fiscal years 1998 through 2002. These assumptions were identified during the second business case workshop.

- There will be significant reductions in Federal and contractor facilities and resources.
- Across-the-board qualification standards will be required for Federal employees.
- The outsourcing of service functions will increase.
- The privatization of DOE assets will increase.
- There will be increased acceptance, and utilization, of advanced training technologies.
- The Department will continue to evolve towards centralized coordination with decentralized design, development, and distribution of education and training through the use of Centers of Excellence.
- Computer-based training (CBT) will become more sophisticated through the use of enhanced graphics, animation, video, and sound. It is expected that thousands of programs will be available commercially.
- Internet access will be readily available to employees at all work stations. Increased bandwidth and compression techniques will allow greater use of multimedia capabilities.

- The lines that currently separate the capabilities of interactive television, multimedia, and Internet will gradually disappear, allowing true integration of these technologies, as well as other advanced technologies.

5.2 Technical Solution Models

The identification of the delivery methods to be used in the development of the alternatives was one of the primary objectives of the third business case workshop held in July 1996. The alternatives selected for this business case serve as models of different technical solutions. The models were built using a common set of parameters and assumptions that enable the comparison of different mixes of traditional and advanced training technologies. These models are needed to provide a basis for determining the most cost-effective alternative. The models are not intended to be real-time scenarios. The actual implementation of the recommended technical solution will involve resolution of many Departmentwide and site-specific issues that will affect the acquisition and distribution of technology (timing and quantity), and the selection, development, or conversion of specific courseware, and the achievement of organizational changes.

Within each alternative, four delivery methods are considered: interactive television (e.g., satellite) multimedia (e.g., computer-based training), Internet, and traditional (e.g., classroom). For the corporate approach alternatives (A, B, C, and D), the goal is to deliver 150 cross-cutting learning activities via advanced training technologies in a 5-year period from 1998 through 2002. The remaining learning activities will continue to be delivered via traditional methods. No attempt has been made to identify the specific learning activities that would be converted. This decision would be made on a case-by-case basis by subject matter experts using predetermined selection criteria within the framework of the Systematic Approach to Training.

The primary differences between the alternatives occur in one or both of the following areas: (1) the percentage of 150 cross-cutting learning activities that will be developed or converted for each delivery method (i.e., delivery method mix); and (2) the delivery method that will have the major focus for technology acquisition. Table 5-1 provides a summary of the delivery method mix for each alternative.

Table 5-1. Summary of Business Case Alternatives and Assumptions

Delivery Method	Alternative Summary (for 5-year period)				
	"A" ITV Focus	"B" Multimedia Focus	"C" High-Speed Network Focus	"D" Multi-Technology Solution	"E" Non-Corporate Approach
Interactive Television (ITV)	75 courses converted; 137,625 potential students	19 courses converted; 34,865 potential students	19 courses converted; 34,865 potential students	45 courses converted; 82,575 potential students	19 courses converted; 34,865 potential students
Multimedia	45 courses converted; 115,200 potential students	110 courses converted; 281,600 potential students	110 courses converted; 281,600 potential students	83 courses converted; 212,480 potential students	10 courses converted; 25,600 potential students
Internet	30 courses converted; 52,920 potential students	21 courses converted; 37,044 potential students	21 courses converted; 37,044 potential students	22 courses converted; 38,808 potential students	12 courses converted; 21,168 potential students
Traditional Delivery Methods	remainder of courses	remainder of courses	remainder of courses	remainder of courses	remainder of courses
Capital Investment (for 5-year period)	\$9,221,562	\$10,407,508	\$10,407,508	\$9,184,487	\$3,385,149
Operating Costs (for 5-year period)	\$27,183,552	\$26,087,967	\$26,170,182	\$26,605,734	\$7,691,152
Return on Investment (Net Benefit) for 5-year period)	\$60,302,037	\$65,420,479	\$65,349,623	\$66,902,297	\$2,096,051

Note: Return on Investment (Net Benefit) is obtained by subtracting the capital investments and operating expenses from the gross benefits

The presentation of each alternative is divided into the following sections.

Description: Highlights the important features of the alternative and provides information about the proposed delivery method mix of advanced training technologies.

Approach for Meeting Training Needs: Explains the overall implementation strategy. Partnering agreements will play a major role in providing cost-effective technology-supported learning. Several partnering opportunities are cited in the alternatives. As technology-supported learning delivery methods are implemented, partnering agreements will be explored and pursued on a case-by-case basis.

Platform Descriptions: Explains the platform requirements for each delivery method included in the delivery method mix.

Technology Acquisition: Explains the phased approach, by fiscal year, for acquiring technology and related organizational changes to support the implementation of the delivery method mix. Some alternatives will include establishing Centers of Excellence for multimedia development and delivery. For example, Development Centers of Excellence would create cross-cutting multimedia courseware. The courseware would be turned over to a delivery Center of Excellence for duplication, packaging, and distribution to DOE learning centers.

Note: The technology acquisitions for fiscal year 1997 are provided for informational purposes only. The benefits and costs associated with fiscal year 1997 acquisitions are not included in the analysis of benefits and costs.

Matrix: Provides a tabular summary of the phased approach to the delivery method mix and technology acquisition. The matrix also includes estimates for the number of courses represented by the delivery method mix percentages, and the number of courses projected to be converted each year.

The potential number of students who could receive the training for each course that is converted is provided for each year. For example, it was estimated that in one year an average of 1,835 students across the DOE complex would have access to any course delivered via interactive television. If nine classroom-delivered courses are converted to an interactive television format in one year, then the potential exists for 16,515 students to participate in that interactive television training.

5.3 Comparison of Alternatives

An analysis of benefits and costs was performed on each alternative (chapter 6). The results of the analysis provide data for comparing the alternatives to determine which one provides the most desired benefits for the least cost and the best long-term return on investment. The return on investment for each business case alternative (A-E) is provided in table 5-1. This financial information was an important factor in the analysis of the alternatives and the development of the business case recommendations.

5.4 Multi-Technology Solution (Alternative D)

5.4.1 Description

This alternative is a synthesis of the other corporate approach alternatives (A, B, and C). It focuses on optimizing the use of existing and projected Departmental interactive television, multimedia, and Internet resources, rather than maximizing one particular delivery method. For example, interactive television is used to its projected maximum level that is possible without further studio or uplink acquisition. Internet is projected to combine with multimedia only when high-speed network capabilities mature throughout the Department. Viewed as projective rather than prescriptive, the 5-year goal for the Multi-Technology Solution is to deliver a minimum of 150 cross-cutting learning activities using the following delivery technology mix:

- 45 (30 percent) via interactive television
- 83 (55 percent) via multimedia
- 22 (15 percent) via Internet

The remaining learning activities, not delivered through advanced training technologies, are assumed to be delivered through traditional classroom and self-study methods.

5.4.2 Approach for Meeting Training Needs

A 5-year phased approach is assumed for implementation of the Multi-Technology Solution starting in fiscal year 1998. This approach encompasses learning activity development and delivery, technology infrastructure acquisition, and organizational changes. As is the case with all of the corporate approach alternatives, standards must continue to evolve for learning activity design and delivery to be compatible and widespread. Acquisition of free courseware from partners outside the Department and from other sources would be expected to decrease the need for in-house development by 10-20 percent depending on the delivery method type.

The Multi-Technology Solution shares the delivery method focus between interactive television (alternative A) and multimedia (alternative B). It represents a very probable scenario where the existing satellite uplink and downlink, and planned additional downlink facilities, are heavily used, but no additional uplinks are built. Partnering may enable use of non-DOE-owned studios and uplink facilities.

Slightly fewer learning centers with slightly fewer multimedia computers are projected than would be acquired for alternative B, which focuses on multimedia. Learning activities projected for multimedia (e.g., CD-ROM delivery at local learning centers and eventually the desktop) could be modified or easily re-purposed for Web delivery or both CD-ROM and Internet distribution and delivery.

This alternative does not take an overly optimistic view regarding the availability of high-speed networks capable of transmitting extensive multimedia information to the desktops, as projected in alternative C. While it is believed that such capabilities will be in existence commercially and to

some extent within the DOE, Information Management (IM) representatives were not able to predict when the capabilities would be in widespread use across the Department.

The Multi-Technology Solution delivery method mix of learning activities for fiscal years 1998 through 2002 is shown in table 5-2 at the end of this section.

5.4.3 Platform Descriptions

Interactive Television. The primary ITV platform provides an appropriate infrastructure for the delivery of interactive cross-cutting education and training learning activities via satellite to remote locations. In the short term, both analog and digital satellite formats would be needed to accommodate current capabilities, since some DOE sites have analog and some have digital capabilities. Also, some sites have fixed dishes and others have steerable dishes. The long-term solution is to move toward a fully compatible, digital capability throughout the Department.

The platform for the first 3 years would be a satellite system that is compatible with the system in operation at the Central Training Academy (CTA) located at DOE facilities in Albuquerque, New Mexico. Compressed digital video transmission would be used to satisfy one-way video requirements. This transmission will be supported by terrestrial two-way audio and viewer response systems for student-instructor interactivity.

The ITV satellite platform consists of three basic components: broadcast studio, uplink-downlink capabilities, and receiver site capabilities.

- A fully operational broadcast studio is located at CTA. It is assumed that this will be the primary DOE studio. Partnering agreements with educational, Government, and commercial vendors will be explored for potential shared use of other studios.
- The CTA satellite uplink consists of a transmission dish along with encoding hardware. It transmits one channel of live or recorded instruction to a satellite in geosynchronous orbit. Partnering agreements with educational, Government, and commercial vendors will be explored for potential shared use of other uplink capabilities.
- Each downlink will consist of a receive-only satellite dish and an integrated receiver/decoder. The Department already has 23 sites with satellite downlink capabilities that provide one-way video with two-way audio and one-way data.
- Each receive site will include, but not be limited to, television monitors, a viewer response system, video cassette recorder(s), and associated components.

Compressed video teleconferencing services (CVTS) and desktop video-conferencing would serve as secondary ITV systems.

- Compressed video teleconferencing services offer two-way video and two-way audio. Many sites already have compressed video teleconferencing capabilities that could be used for delivery of training.
- Desktop video provides two-way video with two-way audio and data. As a training delivery method, this technology provides point-to-point connection that is ideal for remote, one-on-one instructor-to-student training. The most common DOE platform for desktop video is an Intel-based personal computer.

Establishment of partnering agreements to deliver education and training learning activities is an aspect of this alternative that has not been fully explored. Many full-service educational institutions, tele-education, and tele-training companies (such as Wescott Communications, Elkins Interactive, and IDTN) provide complete production and uplink services or some part of those services. The Government Alliance for Training and Education (GATE) successfully completed a multi-agency partnering pilot project that used ITV to deliver ethics training to 7,000 federal employees.

Multimedia. The multimedia/CBT delivery platform includes a personal computer, digital audio, compact disc read-only memory (CD-ROM), color monitor, high resolution graphics, and a touch screen (optional). For the analysis of benefits and costs, the Intel-based personal computer is assumed to be the standard platform for multimedia delivery.

The multimedia/CBT courseware development platform includes authoring software and other development software that enhances courseware development and reduces programming time. Ideally, courseware could be obtained or developed that will run on Windows-based personal computers (as well as Macintosh and Unix platforms that can adequately support Windows applications and multimedia). A standardized platform is a key element to ensure that cross-cutting CBT courseware can be delivered at all sites. If a single platform is required, it will most likely be an Intel-based Windows platform.

Internet. No standard requirement has been identified for Internet-based training except that it should not be DOS-based. The standardization of browsers and plug-ins are considered more essential. “De facto” standards are evolving very rapidly and many are requiring powerful workstations to support useful features.

The following types of Internet World Wide Web pages are considered appropriate for delivery of education and training learning activities.

- Static Web pages are best for relatively low technology applications that are low in cost to convert, such as study guides or textbooks. Examples of appropriate types of training include: slide shows and linear CBT, canned simulations, hypertext and branching CBT, and text-only materials.
- Dynamic Web pages are best for interactive applications such as testing, practice exercises, and data base look-up applications. Examples of appropriate types of training

include server-based common gateway interface scripted, imbedded JAVA or shockwave applets/scripts, drill and practice, and free-play simulations.

5.4.4 Technology Acquisition

The following is a phased approach for the acquisition of the technology needed to successfully implement the Multi-Technology Solution. Also provided are organizational issues, such as the establishment of partnering agreements, that would support the technical implementation plan.

Fiscal Year 1997 (not included in the analysis of benefits and costs)

- ITV: Install one uplink site at the Savannah River Operations Office as part of an arrangement negotiated with the National Technological University. Install five downlink sites.
- MM: Establish standard hardware platform. Survey all sites for present capability and current assets. Identify sites performing courseware development and catalog their capabilities. Align all sites presently using multimedia to the coordination of learning activity development and deployment.

Fiscal Year 1998

- ITV: Install 20 downlink sites. Upgrade infrastructure by adding integrated receiver/decoders and site controllers to increase the number of learning activities that can be received from the satellite. Add keypads and training space to increase student capacity. Begin to explore partnering opportunities for additional uplink capabilities.
- MM: Establish 75 learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center. Solicit existing courseware from all DOE sites. Identify subject matter experts and establish courseware development and delivery method for Centers of Excellence.
- NET: Establish standards for the World Wide Web (WWW) browser software. Adopt standards for the hypertext markup language (HTML) formats used within the DOE complex. Achieve 80 percent Internet connectivity across the DOE complex. It is assumed that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 1999

- ITV: Upgrade infrastructure by adding integrated receiver/decoders and site controllers to increase the number of learning activities that can be received from the satellite and add keypads, and training space to increase student capacity. Establish partnering agreements for delivery of learning activities.

- MM: Establish 40 additional learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center.
- NET: If possible through other initiatives, achieve 100 percent connectivity of all sites across the DOE complex. Purchase site licenses for browser software, including plug-ins necessary to deliver CBT/ITV learning activities.

Fiscal Year 2000

- ITV: Upgrade network infrastructure. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.
- MM: Establish 35 additional learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center. If possible, begin upgrading individual workstations. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level information systems enhancement initiatives.
- NET: Purchase and install network upgrades at each site where necessary to provide high-speed digital transmission. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 2001

- ITV: Where possible, establish bridges to channel ITV broadcast to the desktop.
- MM: Where possible, merge multimedia delivery with Internet capabilities and deliver learning activities via CD-ROM or the high-speed network.
- NET: Begin delivery of CBT learning activities via Internet on the high-speed network.

Fiscal Year 2002

- ITV: If possible, convert some ITV for delivery via high-speed network and merge with Internet capabilities.
- MM: As possible, continue to merge multimedia delivery with Internet capabilities and deliver learning activities via CD-ROM or the high-speed network.
- NET: As possible, begin delivery of ITV/video via Internet on the high-speed network.

Table 5-2. Multi-Technology Solution (Alternative D)

	Year 1 - 1998	Year 2 - 1999	Year 3 - 2000	Year 4 - 2001	Year 5 - 2002	Totals for Each Method
ITV Goal = 30% of courses appropriate for TSL delivery 45 courses: 1,835 average students/course each year	Install 20 downlinks. Upgrade infrastructure. Explore uplink partnering agreements.	Upgrade infrastructure. Establish partnering agreements for course delivery.	Upgrade network infrastructure.	If possible, establish bridges to channel ITV broadcast to desktop	As possible, convert some ITV for delivery via high-speed network and merge with Internet capabilities	
	Convert 9 courses	Convert 9 courses	Convert 9 courses	Convert 9 courses	Convert 9 courses	45 courses converted
	16,515 potential students	16,515 potential students	16,515 potential students	16,515 potential students	16,515 potential students	82,575 potential students
MM Goal = 55% of courses appropriate for TSL delivery 83 courses: 2,560 average students/course each year	Establish 75 learning centers with at least 6 multimedia workstations each. Establish Centers of Excellence.	Establish 40 learning centers with at least 6 multimedia workstations each.	Establish 35 learning centers with at least 6 multimedia workstations each. Begin upgrading individual workstations.	Where possible, merge with Internet capabilities. Deliver via CD-ROM or high-speed network.	As possible, continue merge with Internet capabilities; Deliver via CD-ROM or high-speed network.	
	Convert 14 courses	Convert 15 courses	Convert 16 courses	Convert 19 courses	Convert 19 courses	83 courses converted
	35,840 potential students	38,400 potential students	40,960 potential students	48,640 potential students	48,640 potential students	212,480 potential students
Internet Goal = 15% of courses appropriate for TSL delivery 22 courses: 1,764 average students/course each year	Establish standards for WWW browser software. Adopt standards for HTML formats used for TSL. Achieve 80% connectivity across DOE.	Achieve 100% connectivity across DOE complex. Purchase site licenses for browser software, including plug-ins necessary to deliver CBT/ITV.	Purchase and install network upgrades at each site where necessary to provide high-speed digital transmission.	Where possible, begin delivery of CBT via Internet on the high-speed network.	Where possible, begin delivery of ITV/video via Internet on the high-speed network.	
	Convert 1 course	Convert 4 courses	Convert 5 courses	Convert 6 courses	Convert 6 courses	22 courses converted
	1,764 potential students	7,056 potential students	8,820 potential students	10,584 potential students	10,584 potential students	38,808 potential students
Totals for Each Year	24 courses converted	28 courses converted	30 courses converted	34 courses converted	34 courses converted	150 courses converted

5.5 Non-Corporate Approach (Alternative E)

5.5.1 Description

By fiscal year 2002, it is assumed that a minimum of 41 cross-cutting education and training learning activities would be delivered via advanced training technologies if the non-corporate approach to education and training continues. Based on delivery method suitability characteristics derived from the application of the Distance Learning Appropriateness Screening Tool (DLAST), the following delivery method mix is assumed:

- 19 (46 percent) via ITV
- 10 (24 percent) via multimedia
- 12 (30 percent) via Internet

The remaining learning activities, not delivered through advanced training technologies, are assumed to be delivered by traditional classroom and self-study methods.

5.5.2 Approach for Meeting Training Needs

This alternative represents the non-corporate approach DOE organizations are currently using to develop and deliver education and training learning activities. It is assumed that the organizations using advanced training technologies will continue to expand their efforts without the benefit of Departmentwide standards, processes, infrastructure, or development and delivery partnering agreements. The following list includes some of the characteristics of the non-corporate approach.

- Limited sharing and dissemination of information regarding available resources and learning activities.
- No central source for administrative information related to the selection and delivery of learning activities.
- Significant redundancies in courseware development and availability.
- No standards for advanced training technology platforms.
- Each DOE site or organization is independently funding education and training opportunities for its own employees.

The Non-Corporate Approach delivery method mix of learning activities for fiscal years 1998 through 2002 is shown in table 5-3 at the end of this section.

5.5.3 Platform Descriptions

A detailed explanation of the various platforms are provided in the Multi-Technology Solution see (section 5.4.3).

Interactive Television. Both analog and digital satellite formats are needed to accommodate current capabilities. No plans are in place to adopt a standard platform for full compatibility across the Department. Organizations are independently acquiring technology that is compatible with the delivery methods of the courseware providers they are using. Compatibility will occur between sites that acquire downlinks for the satellite used by both the Central Training Academy and National Technological University.

Multimedia. Courseware would be obtained or developed that will run on Windows-based personal computers, Macintosh or Unix platforms with multimedia equipment, but not necessarily all three. No plans are in place to adopt a standard platform for full compatibility across the Department.

Internet. No standard requirement has been identified for Internet-based training.

5.5.4 Technology Acquisition

The following approach is assumed for the acquisition of technology in the non-corporate environment of this alternative. Also provided are organizational issues, such as the establishment of partnering agreements, that would be expected to evolve in support of the technical acquisitions.

Fiscal Year 1997 (not included in the analysis of benefits and costs)

ITV: Install one uplink site at the Savannah River Operations Office as part of an arrangement negotiated with the National Technological University. Install five downlink sites.

Fiscal Year 1998

ITV: Install four downlink sites.

MM: Establish nine learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center.

Fiscal Year 1999

ITV: Install four downlink sites.

MM: Establish nine learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center.

NET: Achieve 80 percent connectivity of all sites across the DOE complex. It is assumed that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 2000

ITV: Install four downlink sites.

MM: Establish nine learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center.

NET: Achieve 100 percent connectivity of all sites across the DOE complex. It is assumed that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 2001

ITV: Install four downlink sites.

MM: Establish nine learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center.

NET: Upgrade networks to provide Internet access to all desktops. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 2002

ITV: Install four downlink sites.

MM: Establish nine learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center.

NET: Upgrade desktop computers to support Internet access, where needed. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Table 5-3. Non-Corporate Approach (Alternative E)

	Year 1 - 1998	Year 2 - 1999	Year 3 - 2000	Year 4 - 2001	Year 5 - 2002	Totals for Each Method
ITV Goal = 13% of courses appropriate for TSL delivery 1,835 average students/course each year	Install 4 downlink sites.	Install 4 downlinks.	Install 4 downlinks.	Install 4 downlinks.	Install 4 downlinks.	
	convert 3 courses	convert 4 courses	convert 4 courses	convert 4 courses	convert 4 courses	19 courses converted
	5,505 potential students	7,340 potential students	7,340 potential students	7,340 potential students	7,340 potential students	34,865 potential students
MM Goal = 7% of courses appropriate for TSL delivery 2,560 average students/course each year	Establish 9 learning centers with at least 6 multimedia workstations each.	Establish 9 learning centers with at least 6 multimedia workstations each.	Establish 9 learning centers with at least 6 multimedia workstations each.	Establish 9 learning centers with at least 6 multimedia workstations each.	Establish 9 learning centers with at least 6 multimedia workstations each.	
	convert 2 courses	convert 2 courses	convert 2 courses	convert 2 courses	convert 2 courses	10 courses converted
	5,120 potential students	5,120 potential students	5,120 potential students	5,120 potential students	5,120 potential students	25,600 potential students
Internet Goal = 8% of courses appropriate for TSL delivery 1,764 average students/course each year		Achieve 80% connectivity across DOE complex.	Achieve 100% connectivity across DOE complex.	Upgrade networks to provide Internet access to all desktops.	Upgrade desktop computers to support Internet access where necessary.	
	convert 2 courses	convert 2 courses	convert 2 courses	convert 3 courses	convert 3 courses	12 courses converted
	3,528 potential students	3,528 potential students	3,528 potential students	5,292 potential students	5,292 potential students	21,168 potential students
Totals for each year	7 courses converted	8 courses converted	8 courses converted	9 courses converted	9 courses converted	41 courses converted

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6. Analysis of Benefits and Costs

An analysis of benefits and costs is a systematic approach for comparing alternative ways to satisfy an objective. The analysis of benefits and costs provides a structured framework for collecting, analyzing, displaying, and communicating pertinent information to the decision making process. The analysis of benefits and costs process includes the following steps:

- Identify technically and operationally feasible alternatives for satisfying stated objectives
- Identify the benefits and costs of each alternative over the project lifecycle
- Determine when benefits and costs occur
- Compare the alternatives

Benefits result from improved operations or decreased operating costs. Benefits can also result from an increase in capabilities or services available to the organization or the organization's customers. Dollar values are assigned to benefits that are either one-time (non-recurring) or occur over the life of the project (recurring).

Costs are the value of input used or expended in developing, acquiring, or operating a resource. Costs that are incurred throughout the life of a project are identified and estimated. Non-recurring costs are the one-time expenses, such as tailoring of facilities, purchase of equipment, and development of courseware. Recurring costs are expenses that occur on a regular basis throughout the life of the project, such as equipment maintenance, studio time, instructor costs, and transmission costs. Sunk costs are already expended and are not included in the analysis of benefits and costs. For this analysis, dollars expended in fiscal year 1997 are considered sunk costs.

6.1 Methodology Used for Business Case

The methodology described in the Department of Energy's *Analysis of Benefits and Costs (ABC's) Guideline* was used to perform the analysis of benefits and costs on the five technology-supported learning alternatives. This methodology is similar to the discounted cash flow (DCF) technique widely used in the private and public sector. Both methodologies are tools that help decision makers make go/no-go decisions when considering investment opportunities and ranking investments when more than one alternative is available.

The Department's *Analysis of Benefits and Costs (ABC's) Guideline* is based on the understanding that a dollar today is worth more than a dollar a year from now. Two principles were derived from this understanding of a dollar's value.

- Benefits accruing in the future are worth less than the same level of benefits that accrue now.
- Costs that occur in the future are less burdensome than costs that occur now.

To perform this analysis, the benefits and costs that will be derived from investment decisions were identified and quantified. All future cash flows (both positive and negative) were discounted based on the timing of the cash flow and on the discount rate for the entire investment. The discounted cash flows were added together to determine the overall Net Present Value (NPV) of the investment alternative. To determine if an investment should be made, the NPV of the investment should be positive when only one investment is considered, or identify the investment with the highest NPV when more than one alternative is available. Detailed worksheets showing the computational data that was used for the analysis of benefits and costs are available for inspection upon request.

For this analysis of benefits and costs, “real” dollars and discount rates were used rather than “nominal” dollars and rates. Real dollars or “constant” dollars are dollars having the same purchasing power based on a time reference period called the baseline year (in this case fiscal year 1997). This approach explicitly excludes the impact of inflation on both the dollar values and the discount rate. With future amounts expressed in real dollars, it is necessary to adjust the amounts for the opportunity cost of money (i.e., the additional factor that changes the value of money over time). This time adjustment can be accomplished by applying appropriate discount formulas to the future amounts. For this analysis, the Office of Management and Budget (OMB) “real” discount rate of 3.1 percent was used.

Once the benefits and costs were identified, the Net Present Value was used to evaluate each alternative. In this business case, Return on Investment is used synonymously with Net Present Value. Table 6-1 provides a summary of the Net Present Value and payback year for each alternative.

Net Present Value (NPV). NPV is calculated by subtracting the total present value cost from the total present value benefit of the alternative. The NPV is expressed in millions of dollars. The higher an alternative's positive NPV, the more its benefits exceed its costs. From an economic analysis point of view, the alternative with the highest NPV is frequently the most desirable.

There are times when the highest NPV is not the best choice. *Volume 1, A Manager's Guide to Analysis of Benefits and Costs of DOE's Analysis of Benefits and Costs (ABC) Guideline*, states: “Mitigating factors, such as different non-quantifiable benefits among the alternatives, large initial cash outlays, budgetary constraints, manpower restrictions, and other factors may require selection of an alternative that does not have the highest NPV.”

Benefit/Cost Ratio (BCR). DOE's *Analysis of Benefits and Costs (ABC's) Guideline* states that the “benefit/cost ratio (BCR) is the present value of benefits divided by the present value of costs.” The BCR provides a measure of the benefits obtained per dollar spent and is expressed as a decimal number. The BCR is a relative measure of an alternative's value.

Payback Year. Plotting the NPV by year shows where the benefits equal the costs of each alternative, typically called the break-even point. The length of time required to reach the break-even point is called the payback period. The payback year is the year in which the total benefits begin to exceed the total costs for the alternative.

Table 6-1. Summary of Analysis Results

Alternative	Net Present Value or Return On Investment	Benefit/ Cost Ratio	Payback Year
A - Focus on Interactive Television	\$60,302,037	2.89	1999
B - Focus on Multimedia	\$65,420,479	3.03	1999
C - Focus on High-Speed Networks	\$65,349,623	3.02	1999
D - Multi-Technology Solution	\$66,902,297	3.12	1999
E - Non-Corporate Approach	\$ 2,096,051	1.22	2001

6.2 Spreadsheet Model Development

The spreadsheet model used for each alternative consists of a series of inputs to calculate the quantifiable costs and benefits associated with each alternative. The following spreadsheets were used in this model.

Assumptions: This worksheet contains on set of general assumptions relating to salaries, technology acquisition costs, travel costs, etc. that were used to analyze and compare all alternatives (table G-1 in appendix G). The assumptions were based on actual Departmental experience when relevant data was available for analysis. Appendix G contains the assumptions and their definitions.

Alternative Characterization: This worksheet contains information on course conversion, technology acquisition, and partnering plans for the specific alternative being considered. Each alternative has its own Alternative Characterization worksheet.

Usage Estimates: This worksheet contains summary information, such as the number of courses offered, average course enrollment, and course length for each alternative. Each alternative has its own Usage Estimates worksheet.

Summary: This worksheet contains the summary of the analysis of benefits and costs that are calculated in the Quantifiable Benefits and Costs worksheets described below. The Summary worksheet also calculates the net present value for each alternative. Each alternative has its own Summary worksheet.

Quantifiable Benefits and Costs (for ITV, MM/CBT, Internet): These worksheets contain the detailed calculations that were used to quantify the benefits and costs of each alternative. These benefits and costs are based on inputs from the Assumptions, Alternative Characterization, and Usage Estimates worksheets and were automatically transferred to the Summary worksheet. The detailed worksheets showing the computational data that was used are available upon request.

Sections 6-4 and 6-5 provide summaries of the analysis of benefits and costs performed for the Multi-Technology Solution (alternative D) and the Non-Corporate Approach (alternative E). A summary of the analysis of benefits and costs for alternatives A, B, and C is provided in appendix G.

Note: Some language inconsistencies occur in the spreadsheets. These inconsistencies do not affect the results of the analysis or the business case recommendations.

6.3 Results of the Analysis of Benefits and Costs

Results of the analysis of benefits and costs indicate that alternatives A through D, which focus on a corporate approach to interactive television, multimedia, and Internet delivery methods, are significantly more cost-effective than the non-corporate approach to technology-supported learning (alternative E). For the 5-year period included in the analysis, alternatives A, B, C, and D each generate a return on investment of at least \$65 million. The non-corporate approach for the same period generates a return on investment of approximately \$2 million.

It should be noted that the return on investment associated with each alternative assumes that once a cross-cutting learning activity is delivered via technology-supported learning, any duplicate learning activities delivered via traditional methods would no longer be available to, or used by, employees with access to that technology-supported learning activity.

6.4 Multi-Technology Solution (Alternative D)

As described in section 5.4, alternative D is the multi-technology solution to technology-supported learning and represents a synthesis of alternatives A through C. This alternative calls for installing digital satellite downlink facilities at 5 sites in fiscal year 1997 and at 23 sites in fiscal year 1998.

Alternative D also calls for establishing a total of 150 MM/CBT learning centers with at least 6 multimedia workstations at each center. The learning centers would be distributed throughout the DOE complex.

It is assumed that local area networks will be upgraded to enable 100 percent connectivity to the Internet by fiscal year 2000, and that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancements.

A total of 150 courses would be converted to a technology-supported learning medium with 45 to ITV, 83 to MM/CBT, and 22 to an Internet format.

A summary of the recurring and non-recurring benefits and costs and the net present value, return on investment, and benefit/cost ratio are provided in table 6-2. Figure 6-1 graphically depicts the individual and cumulative cash flows for this alternative. Table 6-3 provides the alternative D characterization, table 6-4 provides alternative D usage estimates, and table 6-5 provides a summary of the analysis data for alternative D.

Table 6-2. Summary of Alternative D Benefits and Costs

		FY	FY	FY	FY	FY	FY
SUMMARY		97	98	99	00	01	02
<i>ANALYSIS OF BENEFITS AND COSTS</i>							
Non-recurring Benefits		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits		\$ -	\$ 3,871,955	\$ 12,324,463	\$ 22,043,138	\$ 32,381,363	\$ 43,575,744
Total Benefits		\$ -	\$ 3,871,955	\$ 12,324,463	\$ 22,043,138	\$ 32,381,363	\$ 43,575,744
Non-recurring Costs		\$ -	\$ (4,989,315)	\$ (3,357,523)	\$ (3,410,285)	\$ (3,068,923)	\$ (3,068,923)
Recurring Costs		\$ -	\$ (1,541,683)	\$ (2,781,849)	\$ (3,881,936)	\$ (4,528,889)	\$ (5,160,895)
Total Costs		\$ -	\$ (6,530,998)	\$ (6,139,372)	\$ (7,292,220)	\$ (7,597,812)	\$ (8,229,818)
Return on Investment		\$ -	\$ (2,659,043)	\$ 6,185,091	\$ 14,750,918	\$ 24,783,550	\$ 35,345,926
			3.1%				
Return on Investment (Net Present Value)		\$ 66,902,297					
Payback Year		FY 99					
Benefit/ Cost Ratio		3.12					
Total Capital Invested		\$ 9,184,487					

Figure 6-1. Alternative D Cash Flows

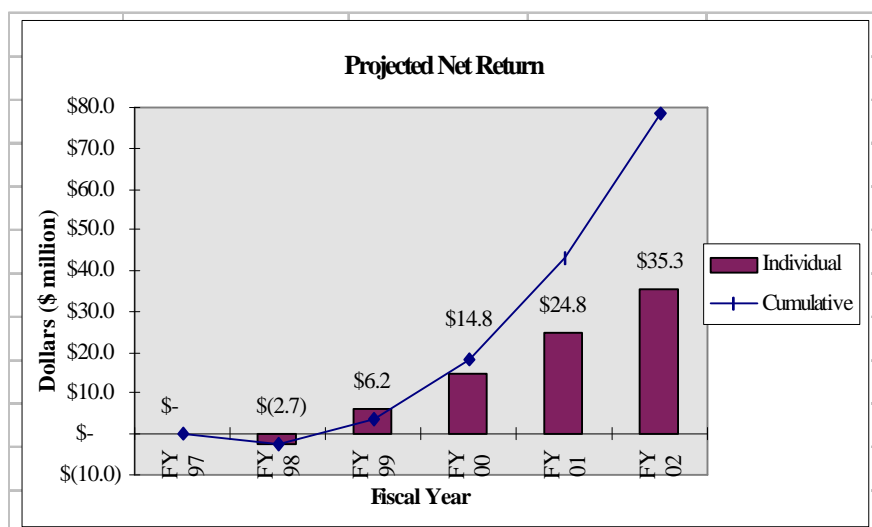


Table 6-3. Alternative D Characterization
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	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02
Alternative Characterization						
<i>Courses Converted</i>						
ITV		9	9	9	9	9
Multi-Media / CBT		14	15	16	19	19
Internet		1	4	5	6	6
Total Courses Converted		0	24	28	30	34
<i>Cumulative Courses Converted</i>						
ITV		0	9	18	27	36
Multi-Media / CBT		0	14	29	45	64
Internet		0	1	5	10	16
Total Courses Converted		0	24	52	82	116
<i>Technology Acquisition</i>						
Satellite Uplink Facilities		1	0	0	0	0
Satellite Downlink Facilities		5	23	0	0	0
Classroom Conversion to ITV			23	0	0	0
Classroom conversion to training center			75	40	35	0
Number of Computers per training center			6	6	6	6
ITV Production Studios			0	0	0	0
MM / CBT computers (in training centers)			450	240	210	0
MM / CBT computers (stand alone Internet)			0	0	0	0
Servers needed to support Internet			0	0	0	0
<i>Technology Acquisition (Cumulative)</i>						
Satellite Uplink Facilities		0	0	0	0	0
Satellite Downlink Facilities			23	23	23	23
Classroom Conversion to ITV			23	23	23	23
Training Centers			75	115	150	150
Production Studios			0	0	0	0
Multi-media computer platforms			0	0	0	0
<i>Partnerships for ITV Course Development (approximate percent of total)</i>						
Partnering (2 way - 50%)		10%	10%	10%	10%	20%
Partnering (5 way - 20%)		10%	10%	10%	10%	20%
DOE Developed (100%)		80%	80%	80%	80%	60%
Discount Multiplier		87%	87%	87%	87%	74%
<i>Partnerships for MM Course Development (approximate percent of total)</i>						
Obtained Free [0% of full cost] (% of total converted)		20%	20%	20%	20%	20%
Partnering [33% of full cost] (% of total converted)		10%	10%	10%	10%	10%
Purchased [67% of full cost] (% of total converted)		20%	20%	20%	20%	20%
Internally Developed [full cost] (% of total converted)		50%	50%	50%	50%	50%
<i>Partnerships for MM Course Development (by course)</i>						
Obtained Free [0% of full cost]	(Courses)	-	2.0	3.0	3.0	3.0
Partnering [33% of full cost]	(Courses)	-	1.0	1.0	1.0	1.0
Purchased [67% of full cost]	(Courses)	-	2.0	3.0	3.0	3.0
Internally Developed [full cost]	(Courses)	-	9.0	8.0	9.0	12.0
<i>Partnerships for Internet Course Development (approximate percent of total)</i>						
Free (0%)		5%	5%	5%	5%	10%
Partnering (3 way - 33%)		5%	5%	5%	5%	10%
DOE Developed (100%)		90%	90%	90%	90%	80%
Discount Multiplier		92%	92%	92%	92%	83%
<i>ITV Quality (% of courses of each type)</i>						
High Quality (\$15,000 / hour)		50%	50%	50%	50%	50%
Junior College Type (\$4,000 / hour)		50%	50%	50%	50%	50%
<i>Percent of Courses Updated (yearly)</i>						
ITV		20%	20%	20%	20%	20%
MM / CBT		20%	20%	20%	20%	20%
Internet		20%	20%	20%	20%	20%
<i>Average Class Enrollment Assumptions</i>						
ITV		1,835	1,835	1,835	1,835	1,835
MM / CBT		2,560	2,560	2,560	2,560	2,560
Internet		1,764	1,764	1,764	1,764	1,764
<i>Corporate/ Non-corporate approach Multipliers</i>						
Enrollment (due to advertisement)		100%	100%	100%	100%	100%
Conversion Cost						
MM / CBT Conversion Learning Curve		100%	100%	100%	100%	100%
Elimination of Redundant MM / CBT Course Devlp.		100%	100%	100%	100%	100%
MM / CBT Conversion Cost Multiplier		100%	100%	100%	100%	100%
MM / CBT Incompatibility		100%	100%	100%	100%	100%

Table 6-4. Alternative D Usage Estimates

		FY	FY	FY	FY	FY	FY
<i>USAGE ESTIMATES</i>		97	98	99	00	01	02
<i>ITV Training</i>							
Number of Organizations using ITV			20	43	43	43	43
Number of courses offered using ITV			4	13	22	31	40
Average Length of Course (post converted hours)		6	6	6	6	6	6
Number of Students per course using ITV		1835	1835	1835	1835	1835	1835
Course Compression time (% of lecture time)			65%	65%	65%	65%	65%
Pre-Converted Course Length	(hours)		9.23	9.23	9.23	9.23	9.23
Classroom Instructor Prep Time	hours / course hour		4	4	4	4	4
ITV Prep Ratio (hr Prep per hr. class)			5	5	5	5	5
Percent of Classes needing a Facilitator			50%	50%	50%	50%	50%
Facilitator Time required per class(hours / class)			16	16	16	16	16
Total Number of Courses delivered			4	13	22	31	40
Total Number of Classes (# courses times # sites)			80	559	946	1,333	1,720
Total Number of Students			7,340	23,855	40,370	56,885	73,400
Total Hours of Instruction			44,040	143,130	242,220	341,310	440,400
Students who avoid travel with ITV			147	477	807	1,138	1,468
<i>Multi-Media / Computer Based Training</i>							
Number of organizations using multi-media courses			50	50	50	50	50
Number of courses offered using MM / CBT		0	7	21	37	54	73
Average Length of Course (hours)		6	6	6	6	6	6
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length		9.2	9.2	9.2	9.2	9.2	9.2
Percent of Courses "Refreshed" each year		20%	20%	20%	20%	20%	20%
Centralized Help Line Support (FTEs per year)			1	1	1	1	1
Proctors / Training Center (FTEs / center)			0.20	0.20	0.20	0.20	0.20
Average Number of Students per course		2,560	2,560	2,560	2,560	2,560	2,560
Total Number of Students Instructed		-	17,920	53,760	94,720	138,240	186,880
Students who avoid travel with MMCBT			358	1,075	1,894	2,765	3,738
<i>Internet Training</i>							
Number of organizations using Internet			50	50	50	50	50
Number of courses offered using Internet		0	0.5	3	7.5	13	19
Average Length of Course (hours)		6	6	6	6	6	6
Number of Times Course is Delivered		3	3	3	3	3	3
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length	(hours)	9.2	9.2	9.2	9.2	9.2	9.2
Average Number of Students per course		1,764	1,764	1,764	1,764	1,764	1,764
Total Number of Students		-	882	5,292	13,230	22,932	33,516
Total Hours of Instruction			5,292	31,752	79,380	137,592	201,096
Students who avoid travel with Internet training			18	106	265	459	670

Table 6-5. Summary of Alternative D Analysis Data

		FY 97	FY 98	FY 99	FY 00	FY 01	FY 02
SUMMARY							
Non-recurring Benefits							
No "Non-recurring Benefits" identified							
Total Non-recurring Benefit		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits							
<i>ITV</i>							
Reduction in Student Air Travel Costs	(\$ / year)	\$ -	\$ 322,960	\$ 1,049,620	\$ 1,776,280	\$ 2,502,940	\$ 3,229,600
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 41,104	\$ 133,588	\$ 226,072	\$ 318,556	\$ 411,040
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ -	\$ 24,080	\$ 78,260	\$ 132,440	\$ 186,620
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 1,264	\$ 8,832	\$ 14,947	\$ 21,061	\$ 27,176
Course Compression	(\$ / year)	\$ -	\$ 829,985	\$ 2,697,450	\$ 4,564,915	\$ 6,432,381	\$ 8,299,846
	Sub-total	\$ -	\$ 1,195,313	\$ 3,913,570	\$ 6,660,474	\$ 9,407,378	\$ 12,154,282
<i>MULTI-MEDIA / CBT</i>							
Reduction in Student Air Travel Costs	(\$ / year)	\$ -	\$ 394,240	\$ 1,182,720	\$ 2,083,840	\$ 3,041,280	\$ 4,111,360
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 50,176	\$ 150,528	\$ 265,216	\$ 387,072	\$ 523,264
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ 73,500	\$ 220,500	\$ 388,500	\$ 567,000	\$ 766,500
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 5,530	\$ 16,590	\$ 29,230	\$ 42,660	\$ 57,670
Course Compression	(\$ / year)	\$ -	\$ 2,026,338	\$ 6,079,015	\$ 10,710,646	\$ 15,631,754	\$ 21,131,815
	Sub-total	\$ -	\$ 2,549,784	\$ 7,649,353	\$ 13,477,432	\$ 19,669,766	\$ 26,590,609
<i>INTERNET</i>							
Reduction in Student Air Travel Costs	(\$ / year)	\$ -	\$ 19,404	\$ 116,424	\$ 291,060	\$ 504,504	\$ 737,352
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 2,470	\$ 14,818	\$ 37,044	\$ 64,210	\$ 93,845
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ 5,250	\$ 31,500	\$ 78,750	\$ 136,500	\$ 199,500
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ -	\$ 395	\$ 2,370	\$ 5,925	\$ 10,270
Course Compression	(\$ / year)	\$ -	\$ 99,734	\$ 598,403	\$ 1,496,008	\$ 2,593,080	\$ 3,789,886
	Sub-total	\$ -	\$ 126,857	\$ 761,540	\$ 1,905,232	\$ 3,304,219	\$ 4,830,853
Total Recurring Benefit		\$ -	\$ 3,871,955	\$ 12,324,463	\$ 22,043,138	\$ 32,381,363	\$ 43,575,744
Non-Recurring Costs							
<i>ITV</i>							
Studios	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Uplinks	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Downlinks	(\$ / year)	\$ -	\$ 460,000	\$ -	\$ -	\$ -	\$ -
Classroom Conversion	(\$ / year)	\$ -	\$ 345,000	\$ -	\$ -	\$ -	\$ -
Course Conversion (ITV)	(\$ / year)	\$ -	\$ 686,631	\$ 686,631	\$ 686,631	\$ 584,031	\$ 584,031
	Sub-total	\$ -	\$ 1,491,631	\$ 686,631	\$ 686,631	\$ 584,031	\$ 584,031
<i>MULTI-MEDIA / CBT</i>							
Cost of MM computers (stand alone)	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Training Centers (w / computers)	(\$ / year)	\$ -	\$ 1,950,000	\$ 1,040,000	\$ 910,000	\$ -	\$ -
Course Distribution	(\$ / year)	\$ -	\$ 28,000	\$ 30,000	\$ 32,000	\$ 38,000	\$ 38,000
Course Conversion Costs	(\$ / year)	\$ -	\$ 1,477,385	\$ 1,431,692	\$ 1,570,154	\$ 1,985,538	\$ 1,985,538
	Sub-total	\$ -	\$ 3,455,385	\$ 2,501,692	\$ 2,512,154	\$ 2,023,538	\$ 2,023,538

Table 6-5. Summary of Alternative D Analysis Data (continued)

INTERNET							
Server Acquisition and Installation	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Course Conversion Costs	(\$ / year)	\$ -	\$ 42,300	\$ 169,200	\$ 211,500	\$ 461,354	\$ 461,354
Training Platforms	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	Sub-total	\$ -	\$ 42,300	\$ 169,200	\$ 211,500	\$ 461,354	\$ 461,354
Total Non-Recurring Costs		\$ -	\$ 4,989,315	\$ 3,357,523	\$ 3,410,285	\$ 3,068,923	\$ 3,068,923
Recurring Costs							
ITV							
Studio Operations Costs	(\$ / year)	\$ -	\$ 58,464	\$ 190,008	\$ 321,552	\$ 453,096	\$ 584,640
Instructor Preparation	(\$ / year)	\$ -	\$ 10,962	\$ 35,627	\$ 60,291	\$ 72,261	\$ 93,240
Course Update	(\$ / year)	\$ -	\$ 3,341	\$ 10,858	\$ 18,374	\$ 22,022	\$ 28,416
Satellite Air Time	(\$ / year)	\$ -	\$ 8,394	\$ 27,280	\$ 46,166	\$ 55,331	\$ 71,395
Uplink Service charge	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Facilitator Cost	(\$ / year)	\$ -	\$ 67,200	\$ 469,560	\$ 794,640	\$ 1,119,720	\$ 1,444,800
Downlink service charge	(\$ / year)	\$ -	\$ 211,968	\$ 211,968	\$ 211,968	\$ 211,968	\$ 211,968
Terrestrial Line Usage	(\$ / year)	\$ -	\$ 2,304	\$ 16,099	\$ 27,245	\$ 38,390	\$ 49,536
	Sub-total	\$ -	\$ 362,633	\$ 961,399	\$ 1,480,236	\$ 1,972,789	\$ 2,483,995
MULTI-MEDIA / CBT							
Course Update	(\$ / year)	\$ -	\$ 25,200	\$ 75,600	\$ 133,200	\$ 194,400	\$ 262,800
Training Center computer maintenance	(\$ / year)	\$ -	\$ 26,250	\$ 40,250	\$ 52,500	\$ 52,500	\$ 52,500
Centralized Help Line Support	(\$ / year)	\$ -	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000
Site Proctors / Systems Administrators	(\$ / year)	\$ -	\$ 1,050,000	\$ 1,610,000	\$ 2,100,000	\$ 2,100,000	\$ 2,100,000
Course Re-distribution	(\$ / year)	\$ -	\$ 7,000	\$ 21,000	\$ 37,000	\$ 108,000	\$ 146,000
	Sub-total	\$ -	\$ 1,178,450	\$ 1,816,850	\$ 2,392,700	\$ 2,524,900	\$ 2,631,300
INTERNET							
Course Update	(\$ / year)	\$ -	\$ 600	\$ 3,600	\$ 9,000	\$ 31,200	\$ 45,600
	Sub-total	\$ -	\$ 600	\$ 3,600	\$ 9,000	\$ 31,200	\$ 45,600
Total Recurring Costs		\$ -	\$ 1,541,683	\$ 2,781,849	\$ 3,881,936	\$ 4,528,889	\$ 5,160,895
		FY	FY	FY	FY	FY	FY
SUMMARY		97	98	99	00	01	02
ANALYSIS OF BENEFITS AND COSTS							
Reduction in Operating Costs		\$ -	\$ 3,871,955	\$ 12,324,463	\$ 22,043,138	\$ 32,381,363	\$ 43,575,744
Capital Investment		\$ -	\$ (3,169,664)	\$ (1,760,066)	\$ (1,769,485)	\$ (1,212,077)	\$ (1,273,195)
Operating Expenses		\$ -	\$ (3,361,334)	\$ (4,379,306)	\$ (5,522,735)	\$ (6,385,736)	\$ (6,956,623)
Return on Investment		\$ -	\$ (2,659,043)	\$ 6,185,091	\$ 14,750,918	\$ 24,783,550	\$ 35,345,926

6.5 Non-Corporate Approach (Alternative E)

As described in section 5.5, alternative E is the non-corporate approach to education and training and represents the projected state of technology-supported learning within the Department if a corporate approach is not taken.

This alternative calls for installing digital satellite downlink facilities at five sites in fiscal year 1997 and at four sites each year for fiscal years 1998, 1999, 2000, 2001 and 2002.

Alternative E also calls for establishing a total of 45 MM/CBT learning centers with at least 6 multimedia workstations at each center. The learning centers would be distributed throughout the DOE complex.

It is assumed that local area networks will be upgraded to enable 100 percent connectivity to the Internet by fiscal year 2000, and that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancements.

It was estimated that a total of 41 courses would be converted to a technology-supported learning delivery method with 19 to ITV, 10 to MM/CBT, and 12 to an Internet format.

A summary of the recurring and non-recurring benefits and costs and the net present value and benefit/cost ratio are provided in table 6-6. Figure 6-2 graphically depicts the individual and cumulative cash flows for this alternative. Table 6-7 provides the alternative E characterization, table 6-8 provides alternative E usage estimates, and table 6-9 provides a summary of the analysis data for alternative E.

Table 6-6. Summary of Alternative E Benefits and Costs

ANALYSIS OF BENEFITS AND COSTS							
Non-recurring Benefits		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits		\$ -	\$ 444,175	\$ 1,544,217	\$ 2,658,435	\$ 3,861,960	\$ 5,155,189
Non-recurring Costs		\$ -	\$ (1,066,085)	\$ (1,128,785)	\$ (1,128,785)	\$ (1,257,426)	\$ (1,257,426)
Recurring Costs		\$ -	\$ (282,000)	\$ (637,735)	\$ (1,021,272)	\$ (1,428,596)	\$ (1,868,192)
	Net Result	\$ -	\$ (903,910)	\$ (222,303)	\$ 508,378	\$ 1,175,939	\$ 2,029,571
OMB Discount Rate		3.1%					
Net Present Value		\$ 2,096,051					
Return on Investment		46%					
Benefit/ Cost Ratio		1.22					

Figure 6-2. Alternative E Cash Flows

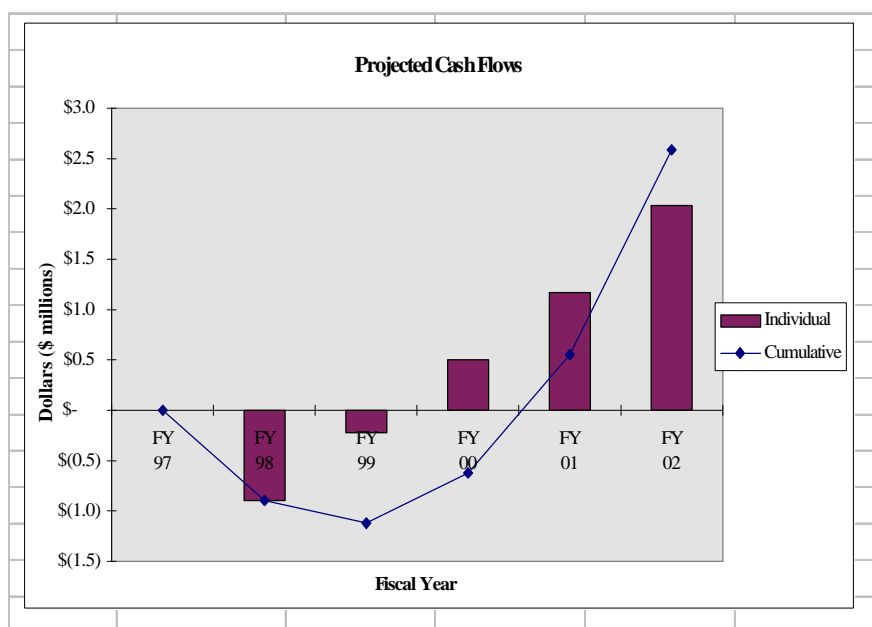


Table 6-7. Alternative E Characterization
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	FY	FY	FY	FY	FY	FY
<i>Alternative Characterization</i>	97	98	99	00	01	02
<i>Courses Converted</i>						
ITV		3	4	4	4	4
Multi-Media / CBT		2	2	2	2	2
Internet		2	2	2	3	3
Total Courses Converted	0	7	8	8	9	9
<i>Cumulative Courses Converted</i>						
ITV	0	3	7	11	15	19
Multi-Media / CBT	0	2	4	6	8	10
Internet	0	2	4	6	9	12
Total Courses Converted	0	7	15	23	32	41
<i>Technology Acquisition</i>						
Satellite Uplink Facilities	1	0	0	0	0	0
Satellite Downlink Facilities	5	4	4	4	4	4
Classroom Conversion to ITV		4	4	4	4	4
Classroom conversion to training center		9	9	9	9	9
Number of Computers per training center		6	6	6	6	6
ITV Production Studios		0	0	0	0	0
MM / CBT computers (in training centers)		54	54	54	54	54
MM / CBT computers (stand alone Internet)		0	0	0	0	0
Servers needed to support Internet		0	0	0	0	0
<i>Technology Acquisition (Cumulative)</i>						
Satellite Uplink Facilities		0	0	0	0	0
Satellite Downlink Facilities		4	8	12	16	20
Classroom Conversion to ITV		4	8	12	16	20
Training Centers		9	18	27	36	45
Production Studios		0	0	0	0	0
Multi-media computer platforms		0	0	0	0	0
<i>Partnerships for ITV Course Development (approximate percent of total)</i>						
Partnering (2 way - 50%)	5%	5%	5%	5%	10%	10%
Partnering (5 way - 20%)	5%	5%	5%	5%	10%	10%
DOE Developed (100%)	90%	90%	90%	90%	80%	80%
Discount Multiplier	94%	94%	94%	94%	87%	87%
<i>Partnerships for MM Course Development (approximate percent of total)</i>						
Obtained Free [0% of full cost] (% of total converted)	20%	20%	20%	20%	20%	20%
Partnering [33% of full cost] (% of total converted)	0%	0%	0%	0%	0%	0%
Purchased [67% of full cost] (% of total converted)	20%	20%	20%	20%	20%	20%
Internally Developed [full cost] (% of total converted)	60%	60%	60%	60%	60%	60%
<i>Partnerships for MM Course Development (by course)</i>						
Obtained Free [0% of full cost] (Courses)	-	-	-	-	-	-
Partnering [33% of full cost] (Courses)	-	-	-	-	-	-
Purchased [67% of full cost] (Courses)	-	-	-	-	-	-
Internally Developed [full cost] (Courses)	-	2.0	2.0	2.0	2.0	2.0
<i>Partnerships for Internet Course Development (approximate percent of total)</i>						
Free (0%)	5%	5%	5%	5%	10%	10%
Partnering (3 way - 33%)	5%	5%	5%	5%	10%	10%
DOE Developed (100%)	90%	90%	90%	90%	80%	80%
Discount Multiplier	92%	92%	92%	92%	83%	83%
<i>ITV Quality (% of courses of each type)</i>						
CTA Level (\$15,000 / hour)	50%	50%	50%	50%	50%	50%
Junior College Type (\$4,000 / hour)	50%	50%	50%	50%	50%	50%
<i>Percent of Courses Updated (yearly)</i>						
ITV	20%	20%	20%	20%	20%	20%
MM / CBT	20%	20%	20%	20%	20%	20%
Internet	20%	20%	20%	20%	20%	20%
<i>Average Class Enrollment Assumptions</i>						
ITV	1,835	1,835	1,835	1,835	1,835	1,835
MM / CBT	2,561	2,561	2,561	2,561	2,561	2,561
Internet	1,765	1,765	1,765	1,765	1,765	1,765
<i>Corporate/ Non-corporate approach Multipliers</i>						
Enrollment (due to advertisement)	65%	65%	65%	65%	65%	65%
Conversion Cost						
MM / CBT Conversion Learning Curve	125%	125%	125%	125%	125%	125%
Elimination of Redundant MM / CBT Course Devlp.	120%	120%	120%	120%	120%	120%
MM / CBT Conversion Cost Multiplier	150%	150%	150%	150%	150%	150%
MM / CBT Incompatibility	70%	70%	70%	70%	70%	70%

Table 6-8. Alternative E Usage Estimates

		FY	FY	FY	FY	FY	FY
USAGE ESTIMATES		97	98	99	00	01	02
<i>ITV Training</i>							
Number of Organizations using ITV			20	24	28	32	36
Number of courses offered using ITV			1	5	9	13	17
Average Length of Course (post converted hours)		6	6	6	6	6	6
Number of Students per course using ITV		1192	1192	1192	1192	1192	1192
Course Compression time (% of lecture time)			85%	85%	85%	85%	85%
Pre-Converted Course Length	(hours)		7.06	7.06	7.06	7.06	7.06
Classroom Instructor Prep Time	hours / course hour		4	4	4	4	4
ITV Prep Ratio (hr Prep per hr. class)			5	5	5	5	5
Percent of Classes needing a Facilitator			50%	50%	50%	50%	50%
Facilitator Time required per class(hours / class)			16	16	16	16	16
Total Number of Courses delivered			1	5	9	13	17
Total Number of Classes (# courses times # sites)			20	120	252	416	612
Total Number of Students			1,192	5,960	10,728	15,496	20,264
Total Hours of Instruction			7,152	35,760	64,368	92,976	121,584
Students who avoid travel with ITV			24	119	215	310	405
<i>Multi-Media / Computer Based Training</i>							
Number of organizations using multi-media courses			50	50	50	50	50
Number of courses offered using MM / CBT		0	1	3	5	7	9
Average Length of Course (hours)		6	6	6	6	6	6
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length		9.2	9.2	9.2	9.2	9.2	9.2
Percent of Courses "Refreshed" each year		20%	20%	20%	20%	20%	20%
Centralized Help Line Support (FTEs per year)			1	1	1	1	1
Proctors / Training Center (FTEs / center)			0.20	0.20	0.20	0.20	0.20
Average Number of Students per course		1,165	1,165	1,165	1,165	1,165	1,165
Total Number of Students Instructed		-	1,165	3,495	5,825	8,155	10,485
Students who avoid travel with MMCBT			23	70	117	163	210
<i>Internet Training</i>							
Number of organizations using Internet			50	50	50	50	50
Number of courses offered using Internet		0	1	3	5	7.5	10.5
Average Length of Course (hours)		6	6	6	6	6	6
Number of Times Course is Delivered		3	3	3	3	3	3
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length	(hours)	9.2	9.2	9.2	9.2	9.2	9.2
Average Number of Students per course		1,147	1,147	1,147	1,147	1,147	1,147
Total Number of Students		-	1,147	3,441	5,735	8,603	12,044
Total Hours of Instruction			6,882	20,646	34,410	51,615	72,261
Students who avoid travel with Internet training			23	69	115	172	241

Table 6-9. Summary of Alternative E Analysis Data

		FY 97	FY 98	FY 99	FY 00	FY 01	FY 02
SUMMARY							
Non-recurring Benefits							
No "Non-recurring Benefits" identified							
Total Non-recurring Benefit		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits							
ITV							
Air Travel Reduction	(\$ / year)	\$ -	\$ 52,448	\$ 262,240	\$ 472,032	\$ 681,824	\$ 891,616
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 6,675	\$ 33,376	\$ 60,077	\$ 86,778	\$ 113,478
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ -	\$ 3,360	\$ 19,600	\$ 40,320	\$ 65,520
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 316	\$ 1,896	\$ 3,982	\$ 6,573	\$ 9,670
Course Compression	(\$ / year)	\$ -	\$ 44,174	\$ 220,871	\$ 397,567	\$ 574,264	\$ 750,960
Sub-total		\$ -	\$ 103,613	\$ 521,743	\$ 953,257	\$ 1,389,758	\$ 1,831,244
MULTI-MEDIA / CBT							
Air Travel Reduction	(\$ / year)	\$ -	\$ 25,630	\$ 76,890	\$ 128,150	\$ 179,410	\$ 230,670
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 3,262	\$ 9,786	\$ 16,310	\$ 22,834	\$ 29,358
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ 10,500	\$ 31,500	\$ 52,500	\$ 73,500	\$ 94,500
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 790	\$ 2,370	\$ 3,950	\$ 5,530	\$ 7,110
Course Compression	(\$ / year)	\$ -	\$ 131,735	\$ 395,204	\$ 658,673	\$ 922,142	\$ 1,185,612
Sub-total		\$ -	\$ 171,917	\$ 515,750	\$ 859,583	\$ 1,203,416	\$ 1,547,250
INTERNET							
Air Travel Reduction	(\$ / year)	\$ -	\$ 25,234	\$ 75,702	\$ 126,170	\$ 189,255	\$ 264,957
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 3,212	\$ 9,635	\$ 16,058	\$ 24,087	\$ 33,722
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ 10,500	\$ 31,500	\$ 52,500	\$ 78,750	\$ 110,250
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ -	\$ 790	\$ 2,370	\$ 3,950	\$ 5,925
Course Compression	(\$ / year)	\$ -	\$ 129,699	\$ 389,098	\$ 648,496	\$ 972,744	\$ 1,361,842
Sub-total		\$ -	\$ 168,645	\$ 506,724	\$ 845,594	\$ 1,268,786	\$ 1,776,696
Total Recurring Benefit		\$ -	\$ 444,175	\$ 1,544,217	\$ 2,658,435	\$ 3,861,960	\$ 5,155,189
Non-Recurring Costs							
ITV							
Studios	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Uplinks	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Downlinks	(\$ / year)	\$ -	\$ 80,000	\$ 80,000	\$ 80,000	\$ 80,000	\$ 80,000
Classroom Conversion	(\$ / year)	\$ -	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000
Course Conversion (ITV)	(\$ / year)	\$ -	\$ 188,100	\$ 250,800	\$ 250,800	\$ 233,365	\$ 233,365
Sub-total		\$ -	\$ 328,100	\$ 390,800	\$ 390,800	\$ 373,365	\$ 373,365
MULTI-MEDIA / CBT							
Cost of MM computers (stand alone)	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Training Centers (w / computers)	(\$ / year)	\$ -	\$ 234,000	\$ 234,000	\$ 234,000	\$ 234,000	\$ 234,000
Course Distribution	(\$ / year)	\$ -	\$ 4,000	\$ 4,000	\$ 4,000	\$ 4,000	\$ 4,000
Course Conversion Costs	(\$ / year)	\$ -	\$ 415,385	\$ 415,385	\$ 415,385	\$ 415,385	\$ 415,385
Sub-total		\$ -	\$ 653,385	\$ 653,385	\$ 653,385	\$ 653,385	\$ 653,385

Table 6-9. Summary of Alternative E Analysis Data (continued)

INTERNET							
Server Acquisition and Installation	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Course Conversion Costs	(\$ / year)	\$ -	\$ 84,600	\$ 84,600	\$ 84,600	\$ 230,677	\$ 230,677
Training Platforms	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	Sub-total	\$ -	\$ 84,600	\$ 84,600	\$ 84,600	\$ 230,677	\$ 230,677
Total Non-Recurring Costs		\$ -	\$ 1,066,085	\$ 1,128,785	\$ 1,128,785	\$ 1,257,426	\$ 1,257,426
Recurring Costs							
ITV							
Studio Operations Costs	(\$ / year)	\$ -	\$ 16,712	\$ 83,561	\$ 150,410	\$ 202,155	\$ 264,356
Instructor Preparation	(\$ / year)	\$ -	\$ 2,945	\$ 14,726	\$ 26,507	\$ 35,627	\$ 46,589
Course Update	(\$ / year)	\$ -	\$ 898	\$ 4,488	\$ 8,078	\$ 10,858	\$ 14,198
Satellite Air Time	(\$ / year)	\$ -	\$ 2,255	\$ 11,276	\$ 20,297	\$ 27,280	\$ 35,673
Uplink Service charge	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Facilitator Cost	(\$ / year)	\$ -	\$ 16,800	\$ 100,800	\$ 211,680	\$ 349,440	\$ 514,080
Downlink service charge	(\$ / year)	\$ -	\$ 36,864	\$ 73,728	\$ 110,592	\$ 147,456	\$ 184,320
Terrestrial Line Usage	(\$ / year)	\$ -	\$ 576	\$ 3,456	\$ 7,258	\$ 11,981	\$ 17,626
	Sub-total	\$ -	\$ 77,050	\$ 292,035	\$ 534,822	\$ 784,796	\$ 1,076,842
MULTI-MEDIA / CBT							
Course Update	(\$ / year)	\$ -	\$ 3,600	\$ 10,800	\$ 18,000	\$ 25,200	\$ 32,400
Training Center computer maintenance	(\$ / year)	\$ -	\$ 3,150	\$ 6,300	\$ 9,450	\$ 12,600	\$ 15,750
Centralized Help Line Support	(\$ / year)	\$ -	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000
Site Proctors / Systems Administrators	(\$ / year)	\$ -	\$ 126,000	\$ 252,000	\$ 378,000	\$ 504,000	\$ 630,000
Course Re-distribution	(\$ / year)	\$ -	\$ 1,000	\$ 3,000	\$ 5,000	\$ 14,000	\$ 18,000
	Sub-total	\$ -	\$ 203,750	\$ 342,100	\$ 480,450	\$ 625,800	\$ 766,150
INTERNET							
Course Update	(\$ / year)	\$ -	\$ 1,200	\$ 3,600	\$ 6,000	\$ 18,000	\$ 25,200
	Sub-total	\$ -	\$ 1,200	\$ 3,600	\$ 6,000	\$ 18,000	\$ 25,200
Total Recurring Costs		\$ -	\$ 282,000	\$ 637,735	\$ 1,021,272	\$ 1,428,596	\$ 1,868,192
ANALYSIS OF BENEFITS AND COSTS							
Non-recurring Benefits		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits		\$ -	\$ 444,175	\$ 1,544,217	\$ 2,658,435	\$ 3,861,960	\$ 5,155,189
Non-recurring Costs		\$ -	\$ (1,066,085)	\$ (1,128,785)	\$ (1,128,785)	\$ (1,257,426)	\$ (1,257,426)
Recurring Costs		\$ -	\$ (282,000)	\$ (637,735)	\$ (1,021,272)	\$ (1,428,596)	\$ (1,868,192)
	Net Result	\$ -	\$ (903,910)	\$ (222,303)	\$ 508,378	\$ 1,175,939	\$ 2,029,571
OMB Discount Rate		3.1%					
Net Present Value		\$ 2,096,051					
Return on Investment		46%					
Benefit/ Cost Ratio		1.22					

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7. Recommendations

The results of the analysis of benefits and cost, and other research data, strongly support the conclusion that an investment in a corporate approach to technology-supported learning is economically feasible. This conclusion and recommendation are consistent with the Departmental Strategic Alignment Implementation Plans that promote the development of a corporate approach to training, a reduction in travel, and the integration of information systems.

7.1 Multi-Technology Solution

The corporate approach to technology-supported learning that is modeled in alternative D is a synthesis of alternatives A, B, and C. This synthesis is a multi-technology solution that encompasses a mix of multimedia, interactive television, Internet, and traditional delivery methods. The acquisition of technology to support each delivery method would occur in parallel efforts according to each sites' priority needs and current disposition toward the technology.

Implementation of the Multi-Technology Solution involves the installation of approximately 25 satellite downlinks at key sites during the targeted 5-year period to accommodate over 90 percent of the DOE employees. In addition, approximately 150 multimedia-equipped learning centers would be established during the same period. While the corporate approach to technology-supported learning would be the primary driver for this technology acquisition, there are non-training applications that would benefit, such as the use of satellite equipment for multipoint meetings and conferences.

It is anticipated that during the 5-year period other information management and telecommunications initiatives, some functioning under partnering agreements with the corporate approach to technology-supported learning, will be drivers for upgrading individual workstations to include multimedia capabilities. Also, some DOE local and wide-area networks will be upgraded and fiber optic cable installed to increase speed and bandwidth. In such cases, the corporate approach to technology-supported learning could be a beneficiary of this technology acquisition.

The development and distribution of courseware for each delivery method would be determined by several factors including: the establishment of Departmental Centers of Excellence and lead sites, the establishment of internal and external partnering agreements, the availability of vendor products and services, and the experience of in-house learning activity developers. Prior to development or conversion to an advanced training technology, each cross-cutting learning activity would be evaluated by instructional designers using the Systematic Approach to Training (SAT) to determine the optimum delivery method or combination of methods.

One goal for the corporate approach to technology-supported learning is to deliver just-in time training to all Federal and contractor employees at their individual workstations. As advanced training technologies evolve and Departmental resources are upgraded, the incorporation of the advanced training delivery methods into one integrated method becomes a reasonable expectation.

7.2 Information Systems Support

It is anticipated that information systems personnel at each DOE site will support the move to advanced training technologies in much the same way as they currently support other technology acquisitions. This support includes procurement efforts (i.e., product/vendor research and acquisition) and system maintenance.

Various information systems support functions were identified during the business case development workshops. This support includes maintaining a central repository of all technology-supported learning activities and supporting online registration for those courses.

Before any new information systems are developed to support a corporate approach to technology-supported learning, the scope and impact of at least two DOE corporate information systems needs to be explored. One of the systems is the Clearinghouse for Training, Education, and Development (CTED). This Internet-based information system is sponsored by the Office of Training and Human Resource Development. The rapidly expanding DOE Universal Catalog is part of the CTED data base. Planned enhancements to CTED include an online scheduling and registration system and the ability to connect to all types of online training resources, such as secure testing, computer-based training, and printed materials. Many of the needs identified during the business case development workshops may be met through existing and planned CTED functions.

The other information system that will affect the corporate approach to technology-supported learning is the Corporate Human Resources Information System (CHRIS). CHRIS will be a Federal-employee human resource and training information management system. Although not planned in the initial system implementation targeted for March 1998, a training module is planned for future inclusion in CHRIS. Efforts to understand the relationship between the CTED and CHRIS are underway.

With a fully functional repository, it should be possible to increase enrollment in technology-supported learning courses by ensuring that all personnel throughout the Department can access information about those courses. Eventually, the use of a central repository should enable students to search for learning activities or courses, register, complete the activity (if it is Internet-based or can be downloaded), complete any online testing, and update their training record. The use of the repository will facilitate the identification and elimination of redundant courses and ensure that a proposed new learning activity or course does not already exist before acquisition, conversion, or development is undertaken.

7.3 Funding Considerations

Fully funding a corporate approach to technology-supported learning for education and training will require money for capital investments, operational costs, and courseware development or conversion. The primary components of capital investments are the computer equipment and related technology acquisitions. The operating expenses include some of the operational costs of

the equipment and technology and the analysis, design, development, implementation/delivery, and evaluation of courseware via advanced training technologies.

For the Multi-Technology Solution, which is recommended, the total budget (i.e., capital investments and operating expenses) involves approximately \$36 million over the 5-year period. Total quantifiable benefits for the 5-year period exceed \$102 million. The anticipated benefits, minus budget costs, indicates a \$66 million net return on investment.

Table 7-1 shows the yearly breakdown of the budget into capital investments and operating expenses. Note: A 3.1 percent inflation rate has been added to the capital investments budget for each fiscal year.

Table 7-1. Five-Year Budget for the Multi-Technology Solution

Fiscal Year	Total Budget (in millions)	Capital Investments (in millions)	Operating Expenses (in millions)
1998	\$ 6.6	\$3.2	\$ 3.4
1999	\$ 6.2	\$1.8	\$ 4.4
2000	\$ 7.3	\$1.8	\$ 5.5
2001	\$ 7.6	\$1.2	\$ 6.4
2002	\$ 8.3	\$1.3	\$ 7.0
Totals	\$36.0	\$9.3	\$26.7

Funding issues will be addressed during the project planning phase of the corporate approach to technology-supported learning. Corporate management of financial resources will be required to support the corporate approach, including the acquisition of the information infrastructure (capital investments). If the DOE training budgets remain at current levels, some of the technology-supported learning operating expenses will be covered by money that is currently spent to develop and deliver training via traditional methods.

7.4 Project Plan

Project planning will identify the specific activities that need to be performed to achieve a fully functional corporate approach to technology-supported learning. Plans will address funding and human resource issues, the acquisition and distribution of technology (timing and quantity), the selection and development or conversion of specific courseware, and the achievement of organizational changes. It is recommended that a Departmental team, comprised of an appropriate mix of experts, be chartered to develop a project plan.

7.5 Implementation Plan

A full-scale implementation plan is needed to investigate and resolve site-specific and Departmentwide implementation issues that result from the project plan. It is recommended that Departmental teams comprised of an appropriate mix of experts be chartered to investigate and develop implementation plans for the following areas:

- Corporate Standards
 - Hardware platforms
 - Software
 - Networks/telecommunications
 - User interface (courseware compatibility)
- Centers of Excellence
 - Development of learning activities
 - Delivery of learning activities
 - Lead sites for technical qualifications
- Central repository of training and education data
 - Departmentwide repository of learning activity offerings (DOE Universal Catalog)
 - Registration and administrative functions (including automated record keeping)
 - Online availability of courseware
- Corporate Technology-Supported Learning Program
 - Corporate policy
 - Technology-Supported Learning Program Manager with Departmentwide oversight
 - Corporate management of resources (human, budget, funding)
 - Internal partnering agreements at each site with a Project Manager for Training and a Project Manager for Technology

7.6 Partnering Agreements

The establishment of internal and external partnering agreements to develop and deliver training and education learning activities is an important factor in the ultimate success of the corporate approach to technology-supported learning. Partnering agreements need to be explored in the following areas.

- Sharing technology and human resources, such as the use of studios and uplinks for ITV
- Developing and delivering courseware

- Providing a forum for sharing learning activities, techniques, and information on new technologies
- Showcasing DOE technology-supported learning capabilities as a model for agency activities

It is recommended that Departmental teams be chartered to expand existing, and pursue additional, partnering agreements in the following areas.

- Organizations within the DOE (including contractor organizations), such as the Office of Nonproliferation and National Security to use their studio at the Central Training Academy
- Other Federal and state government agencies, such as the Federal Aviation Administration to use their studio and uplink facilities
- Educational institutions, such as the National Technological University to receive graduate-level education learning activities
- Commercial vendors (for technology and courseware), such as Hewlett Packard for ITV technology and expertise

The potential for partnering opportunities has been confirmed by representatives of the Federal Aviation Administration, the Internal Revenue Service, and the Social Security Administration. Plans are underway to further explore these opportunities. The Defense agencies also offer significant opportunities for potential partnering.

7.7 Human Factors

Human factors play an important role in the acceptance and success of any program. They can be beneficial or present significant non-quantifiable risks. The DOE Technology-Supported Learning Business Case project team did not have an opportunity to investigate the impact of human factors on the acceptance of a Departmentwide Technology-Supported Learning Program. It is recommended that a Departmental team be chartered to identify and analyze the potential human factors that may impact a DOE Technology-Supported Learning Program, and to suggest ways to mitigate or manage risks. The following are three examples of human factors (benefit versus risk) that might be considered.

- Convenience of learning at desktop/workstation versus getting away from work environment and associated interruptions and distractions.
- Elimination of nonproductive travel time versus the risk that exists for people to avoid or indefinitely delay readily available training.

- Electronic delivery of training at the student's workstation versus the student's desire for tangible evidence of participation in the training session.

7.8 Performance Measures

Performance measures need to be developed to assess the yearly status and progress of the corporate approach to technology-supported learning. It is recommended that a Departmental team be chartered to select, implement, and collect performance measures. The following are some of the measures that would be considered for implementation.

- Reduction in travel expenses
- Avoidance of nonproductive time
- Reduction of learning activity development and delivery redundancies
- Course compression rates for each advanced training technology delivery method
- Student evaluations of learning activities delivered via advanced training technologies
- Schedule of technology acquisitions (planned versus actual)

7.9 Regular Review and Update of the Business Case

As advanced training technologies evolve and Departmental technology resources change, different technology-supported learning solutions may emerge as being more practical and appropriate for the DOE environment. To maintain accuracy and validity, the information contained in the initial business case will need to be reviewed on a regular basis (i.e., yearly) to assess progress; update the technology, infrastructure, and courseware data; recalculate the analysis of benefits and costs; and revise the out-year budgets. The recently chartered Training and Development Coordinating Group, which includes a Technology Applications Corporate Team, may be the natural successor to assume responsibility for the maintenance of the business case.

Appendix A

Action Plan

DOE Approach to Distance Learning

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ACTION PLAN

Department of Energy Distance Learning

TITLE: DOE Approach to Distance Learning

ACTION PLAN: REPORTABLE PROBLEM: REPORTABLE NONCONFORMANCE:

HQ ORGANIZATIONS: HR-2 and HR-4

PROGRAM AND ADMIN FUNCTION: HR-2, Office of Training and Human Resource Development, and HR-4, Office of Information Management

Definition. Distance Learning includes both the teaching and learning aspects of education and training.

DESCRIPTION: A growing number of organizations and individuals within the Department of Energy are interested in implementing distance learning. This is due to recent budget cuts, the Secretary's realignment initiatives, Strategic Alignment Implementation Plans 36, 39 and 44, and the fact that technological tools are maturing and affordable.

To ensure a corporate approach, a plan for implementing Distance Learning is needed. This will guarantee uniform and consistent policy, reduce travel, provide consistent nationwide training and simultaneous training for large groups of people, increase productivity, reduce redundancies, and improve overall efficiency and effectiveness of training delivery and methodologies.

From June through October 1995, DOE representatives, from the education and training and information management communities of interest, participated in a series of four distance learning video conferences to:

- (1) get acquainted,
- (2) lay some groundwork for free flowing communications to occur,
- (3) begin to understand each other's requirements and expectations,
- (4) convey the meaning and value of a partnering agreement, and
- (5) plan some Departmental strategies for implementation of advanced training technologies.

This HR action plan is intended to establish a unified Departmental direction for distance learning.

<u>CRITICAL MILESTONES</u>	<u>ORIGINAL TARGET COMPLETION MONTH/YEAR</u>	<u>REVISED TARGET COMPLETION MONTH/YEAR</u>
1. Identify Home for Distance Learning	2/7/96	
2. Establish a Draft Charter	2/7/96	
3. Develop and Execute Partnering Agreement	2/29/96	
4. Develop a DOE Business Case for Distance Learning		
a. Develop survey for baseline and needs assessment data	2/96 - 3/96	
b. Gather baseline and needs assessment data	3/96 - 4/96	
c. Benchmark DOE against best in class	5/96	
d. Analysis of Benefits and Costs	5/96 - 6/96	
e. Return on Investment	6/96	
f. Report to Home/Champion	7/96	
5. Develop DOE Distance Learning Master Plan	TBD	

SUCCESS INDICATORS FOR CLOSED CORRECTIVE ACTION PLANS:

Is plan closed ___ Yes X No

SIGNATURE: /s/ _____ DATE: 3/27/96

T. W. EVANS
Director for Training and
Human Resource Development

SIGNATURE: /s/ _____ DATE: 3/27/96

S. W. HALL, JR.
Deputy Assistant Secretary for
Information Management

Appendix B

List of Workshop Participants

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Table B-1. Workshop Participants

Name	Phone #	Fax #	Internet	Mail Address	Overnight Delivery
ALBUQUERQUE OPERATIONS OFFICE					
Elizabeth Guerra	505-845-6644	505-845-5831	eguerra@doe.al.gov	E.T.C./QTD	Energy Training Complex
Steve Yazzie	505-845-5301	505-845-5831	syazzie@doe.al.gov	P.O. Box 5400 Albuquerque, NM 87185	1401 Maxwell St. Kirtland Air Force Base-West Albuquerque, NM 87118
OFFICE OF NONPROLIFERATION AND NATIONAL SECURITY - CENTRAL TRAINING ACADEMY					
Don Cook	505-845-6432	505-845-6079		U.S. DOE	same as mail address
Jamie Padilla	505-845-4077	505-845-6079		Bldg. 30133, Kirtland Air Force Base Albuquerque, NM 87117	
DEFENSE PROGRAMS					
Heidi Coblentz	301-903-2485	301-903-8056	heidi.coblentz@dp.doe.gov	U.S. DOE	same as mail address
				19901 Germantown Road Germantown, MD 20874	
ENVIRONMENTAL MANAGEMENT					
Roxanne Timberlake	703-414-0627	703-415-7778	rtrombley%em@doe.gov	Communications Training	same as mail address
				1745 Jefferson Davis Highway Suite 410 Arlington, VA 22202	
HQ - OFFICE OF TRAINING AND HUMAN RESOURCE DEVELOPMENT					
Tanya Luckett	202-426-1516	202-426-1480	tanya.luckett@hq.doe.gov	U.S. DOE	same as mail address
				950 L'Enfant Plaza, SW COMSAT Building Rm 710 Washington, DC 20585	

Table B-1. Workshop Participants

Name	Phone #	Fax #	Internet	Mail Address	Overnight Delivery
HQ - OFFICE OF INFORMATION MANAGEMENT					
Dave Berkau	301-903-3193	301-903-6223	dave.berkau@hq.doe.gov	U.S. DOE 19901 Germantown Road Germantown, MD 20874	same as mail address
Helen Clark	301-903-2507	301-903-2261	helen.clark@hq.doe.gov		
Don Cubbage	301-903-4833	301-903-6223	donnied.cubbage@hq.doe.gov		
Paul Mooney	301-903-0621				
Kathleen Canal	301-903-0615	301-903-0735	kathleen.canal@hq.doe.gov	Computer Data Systems Inc. 656 Quince Orchard Rd., Rm-324 Gaithersburg, MD 20878	same as mail address
IDAHO NATIONAL ENGINEERING LABORATORY					
Bob Richards	208-526-9403	208-526-9650	xrr@inel.gov	Lockheed Martin IdahoTech 1920 Freemont Ave. P.O. Box 1625 Idaho Falls, ID 83415-3855	same as mail address
LOS ALAMOS NATIONAL LABORATORY					
Jud Morhart	505-665-2836	505-665-7862	morhart@lanl.gov	University of California Los Alamos National Lab P.O. Box 1663, MS M704 Los Alamos, NM 87545	University of California Los Alamos National Laboratory 1355 40th Street Los Alamos, NM 87544

Table B-1. Workshop Participants

Name	Phone #	Fax #	Internet	Mail Address	Overnight Delivery
NEVADA OPERATIONS OFFICE					
Carol Floyd	702-295-0122	702-295-2367	floyd@hrd.nv.gov	U.S. DOE-NV 2765 S. Highland Dr., Rm 102 Las Vegas, NV 89109	same as mailing address
OAKLAND OPERATIONS OFFICE					
Dru Burks	510-637-1738		dru.burks@oak.doe.gov	U.S. DOE Oakland Operations Office 1301 Clay Street Rm 700N Oakland, CA 94612-5208	
Morton Lankasky	510-637-1848	510-637-2008	mort.lankasky@oak.doe.gov		
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OAK RIDGE OPERATIONS OFFICE					
Judy DiGregorio	423-241-4576	423-241-4577	digregoriojel@oro.doe.gov	DP-83 P.O. Box 2001 Oak Ridge, TN 37831-8751	U.S. DOE-OR DP-83 200 Administration Rd. Oak Ridge, TN 37831-8751
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION					
Tina McKinley	423-576-3418	423-576-9383	mckinlet@ornl.gov	Oak Ridge Institute for Science 246 Laboratory Road, Bldg. 2714F Oak Ridge, TN 37831-0117	

Table B-1. Workshop Participants

Name	Phone #	Fax #	Internet	Mail Address	Overnight Delivery
PITTSBURGH ENERGY TECHNOLOGY CENTER					
Janet Settles	412-892-4751	421-892-6228	settles@petc.doe	Pittsburgh Energy Technology Center P.O. Box 10940 Pittsburgh, PA 15236	Pittsburgh Energy Technology Center Wallace Road Building 922 Room 122 Pittsburgh, PA 15236
RICHLAND OPERATIONS OFFICE					
Richard Self	509-372-2843	509-376-1466	richard_j_self@rl.gov	U.S. DOE 1816 Terminal Dr., Room 99 Richland, WA 99352	
ROCKY FLATS FIELD OFFICE					
Paul Bakke	303-966-7851	303-966-3418	paul.bakke@rfets.gov	U.S. DOE/RFTS Highway 93 Cactus Road Golden, CO 80402-0928	
Nancy DeFrancesco	303-966-3626	303-966-3392	nancy.defrancesco@rfets.gov		
George Lesko	303-966-5050	303-966-3418	george.lesko@rfets.gov		
Tom Welch	303-966-4132	303-966-3418	tom.welch@rfets.gov		
SAVANNAH RIVER OPERATIONS OFFICE					
Doris Hixon	803-725-1563	803-725-4942	doris.hixon@srs.gov	DOE-SRS P.O. Box A Aiken, SC 29802	Road 1, Bldg. 703-A Aiken, SC 29802
Roosevelt Lovett	803-725-3057	803-725-5833	roosevelt.lovett@srs.gov		

Appendix C

Summary of Baseline Data

(data obtained Summer 1996)

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Table C-1. DOE Elements Providing Input to Baseline Data

data collected Summer 1996
 61 elements identified
 38 responded (62% response rate)

Field Organizations			
Respondents	(20 of 26 = 77%)	No Respondents	(6 of 26 = 23%)
Albuquerque Operations Office Energy Training Center* Amarillo Area Office - Pantex Plant Fernald Area Office Grand Junction Project Office Idaho Operations Office Kansas City Area Office Kansas City Plant Kirtland Area Office Morgantown Energy Technology Center Nevada Operations Office* Oakland Operations Office* Oak Ridge Operations Office* Oak Ridge Inst. for Science & Ed.* Office of Scientific & Technical Info. Ohio Field Office Pittsburgh Energy Technology Center* Richland Operations Office* Rocky Flats Field Office* Savannah River Operations Office* Strategic Petroleum Reserve Project Office Western Area Power Administration		Bartlesville Project Office Bonneville Power Administration Chicago Operations Office Pinellas Plant Sacramento Area Office Southwestern Power Administration	

* indicates a DOE element that sent one or more representatives to at least one workshop

Table C-1. DOE Elements Providing Input to Baseline Data

DOE Headquarters			
Respondents <i>(8 of 19 = 42%)</i>		No Respondents <i>(11 of 19 = 58%)</i>	
Civilian Radioactive Waste Mgmt. Congressional, Public & Intergovernmental Defense Programs* Environment, Safety and Health Environmental Management* Human Resources and Administration Information Management* Training & Human Resources* Inspector General Nonproliferation & National Security Central Training Academy*		Chief Financial Officer Economic Impact & Diversity Energy Efficiency & Renewable Energy Energy Information Administration Energy Research Field Management Fossil Energy General Counsel Hearings and Appeals Nuclear Energy, Science & Tech Policy and International Affairs	

Laboratories			
Respondents <i>(10 of 16 = 62%)</i>		No Respondents <i>(6 of 16 = 38%)</i>	
Brookhaven National Lab Fermi National Accelerator Lab Idaho National Engineering Lab* Lawrence Berkeley National Lab Lawrence Livermore National Lab Lawrence Livermore - Nevada Test Site Los Alamos National Lab* Oak Ridge National Lab Sandia National Lab - New Mexico Stanford Linear Accelerator Center		Argonne National Lab - East Argonne National Lab - West Energy Tech. Engineering Center National Renewable Energy Lab Pacific Northwest National Lab Sandia National Lab - CA	

* indicates a DOE element that sent one or more representatives to at least one workshop

Table C-2. List of Elements in DOE Universe (valid Summer 1996)

Field Organizations				
Site	Location	Employees		
		Federal	Contractor	Total
Alaska Power Administration	Juneau, AK	25	0	25
Albuquerque Courier Section	Albuquerque, NM	73	0	73
Albuquerque Operations Office	Albuquerque, NM	804	123	927
Amarillo Area Office	Amarillo, TX	96	0	96
Argonne Area Office	Argonne, IL	6	0	6
Atlanta Support Office	Atlanta, GA	18	0	18
Bartlesville Project Office	Bartlesville, OK	27	233	260
Batavia Area Office	Batavia, IL			
Billings Area Office	Billings, MT			
Bonneville Power Administration	Portland, OR	3198	0	3198
Boston Support Office	Boston, MA	14	0	14
Brookhaven Area Office	Upton, NY	39	0	39
Carlsbad Area Office	Carlsbad, NM	63	0	63
Chicago Operations Office	Argonne, IL	559	0	559

Information obtained from the Office of Organization and Management, and the Office of Worker Transition

Table C-2. List of Elements in DOE Universe (valid Summer 1996)

Field Organizations				
Site	Location	Employees		
		Federal	Contractor	Total
Chicago Support Office	Argonne, IL	165	0	165
Dallas Support Office	Dallas, TX			
Dayton Area Office	Miamisburg, OH	21	0	21
Denver Support Office	Golden, CO			
Energy Technology Engineering Center	Canoga Park, CA	0	151	151
Energy Technology Engineering Center, Site Office	Canoga Park, CA	3	0	3
Fernald Area Office	Cincinnati, OH	60	2208	2268
Golden Field Office	Golden, CO	40	0	40
Grand Junction Project Office	Grand Junction, CO	22	676	698
Hanford Environmental Health Foundation	Richland, WA			
Idaho Operations Office	Idaho Falls, ID	431	0	431
Kansas City Area Office	Kansas City, MO	68	0	68
Kansas City Plant	Kansas City, MO	66	3563	3629
Kansas City Support Office	Kansas City, MO			

Information obtained from the Office of Organization and Management, and the Office of Worker Transition

Table C-2. List of Elements in DOE Universe (valid Summer 1996)

Field Organizations				
Site	Location	Employees		
		Federal	Contractor	Total
Kirtland Area Office	Albuquerque, NM	49	0	49
Laramie Project Office	Laramie, WY			
Los Alamos Area Office	Los Alamos, NM	62	0	62
Loveland Area Office	Loveland, CO			
Metairie Site Office	New Orleans, LA			
Miamisburg Area Office	Miamisburg, OH			
Morgantown Energy Tech. Center	Morgantown, WV	293	230	523
Mound	Miamisburg, OH	38	1127	1165
Naval Petroleum Reserves in California	Tupman, CA	42	525	567
Naval Petroleum Reserves in Colorado	Colorado	5	43	48
Naval Petroleum Reserves in Utah	Utah	5	43	48
Naval Petroleum Reserves in Wyoming	Casper, WY	5	43	48
Nevada Operations Office	Las Vegas, NV	372	2619	2991
New York Support Office	New York, NY			
Oakland Operations Office	Oakland, CA	273	0	

Information obtained from the Office of Organization and Management, and the Office of Worker Transition

Table C-2. List of Elements in DOE Universe (valid Summer 1996)

Field Organizations				
Site	Location	Employees		
		Federal	Contractor	Total
Oak Ridge Operations Office	Oak Ridge, TN	632	7376	
Office of Scientific and Technical Information	Oak Ridge, TN	134	0	134
Ohio Field Office	Miamisburg, OH	104	4292	4396
Pantex Courier Section	Amarillo, TX	123	2985	3108
Philadelphia Support Office	Philadelphia, PA	15	0	15
Phoenix Area Office	Phoenix, AZ			
Pinellas Area Office	Largo, FL	28	0	28
Pinellas Plant	Largo, FL	0	658	658
Pittsburgh Energy Technology Center	Pittsburgh, PA	309	258	567
Pittsburgh Naval Reactors Office	West Mifflin, PA	62	0	62
Portsmouth Site Office		14	0	14
Princeton Area Office	Princeton, NJ	18	0	18
Richland Operations Office	Richland, WA	532	12719	13251
Rocky Flats Field Office	Golden, CO	297	4460	4757
Sacramento Area Office	Sacramento, CA	298	0	298

Information obtained from the Office of Organization and Management, and the Office of Worker Transition

Table C-2. List of Elements in DOE Universe (valid Summer 1996)

Field Organizations				
Site	Location	Employees		
		Federal	Contractor	Total
Salt Lake City Area Office	Salt Lake City, UT			
San Francisco Support Office	Oakland, CA			
Savannah River Operations Office	Aiken, SC	567	15625	16192
Schenectady Naval Reactors Office	Schenectady, NY	62	0	62
Seattle Regional Support Office	Seattle, WA	235	0	235
Southeastern Courier Section		98	0	98
Southeastern Power Administration	Elberton, GA	42	0	42
Southwestern Power Administration	Tulsa, OK	183	0	183
Stanford Linear Accelerator Center	Menlo Park, CA	0	1245	1245
Stanford Site Office	Stanford, CA	6	0	6
Strategic Petroleum Reserve Office	New Orleans, LA	122	930	1052
Superconducting Super Collider	Dallas, TX	0	933	933
Uranium Mill Tailings Project				

Information obtained from the Office of Organization and Management, and the Office of Worker Transition

Table C-2. List of Elements in DOE Universe (valid Summer 1996)

Field Organizations				
Site	Location	Employees		
		Federal	Contractor	Total
Waste Isolation Pilot Project	Carlsbad, NM	0	637	637
Weldon Spring Site Office		12	0	12
Western Area Power Administration	Golden, CO	1331	0	1331
West Valley Area Office	West Valley, NY	26	957	983
Yucca Mountain Site Characterization Project Office	Yucca, NV	98	644	742

Information obtained from the Office of Organization and Management, and the Office of Worker Transition

Table C-2. List of Elements in DOE Universe (valid Summer 1996)

Laboratories				
Site	Location	Employees		
		Federal	Contractor	Total
Ames Laboratory	Ames, IA	0	55	55
Argonne National Laboratory (East)	Argonne, IL	0	3424	3424
Argonne National Laboratory (West)	Idaho Falls, ID	0	778	778
Bettis Atomic Power Laboratory	Idaho Falls, ID			
Bettis Atomic Power Laboratory	West Mifflin, PA			
Brookhaven National Laboratory	Upton, NY	0	3321	3321
Environmental Measurements Laboratory	New York, NY			
Fermi National Accelerator Laboratory	Batavia, IL	0	2133	2133
Idaho National Engineering Laboratory	Idaho Falls, ID	0	5842	5842
Inhalation Toxicology Research Institute	Albuquerque, NM	0	157	157
Institute of Toxicology and Environmental Health		0	552	552
Knolls Atomic Power Laboratory	Schenectady, NY			
Laboratory of Radiobiology and Environ. Health	San Francisco, CA			
Laboratory of Structural Biology and Molecular Med.	Los Angeles, CA			

Information obtained from the Office of Organization and Management, and the Office of Worker Transition

Table C-2. List of Elements in DOE Universe (valid Summer 1996)

Laboratories				
Site	Location	Employees		
		Federal	Contractor	Total
Lawrence Berkeley Laboratory	Berkeley, CA	15	2249	2264
Lawrence Livermore National Laboratory	Livermore, CA	114	5680	5794
Lawrence Livermore Nat. Lab., Nevada Test Site	Mercury, NV	0	2897	2897
Los Alamos National Laboratory	Los Alamos, NM	0	7145	7145
National Renewable Energy Laboratory	Golden, CO	0	877	877
New Brunswick, Laboratory	Argonne, IL			
Oak Ridge National Laboratory	Oak Ridge, TN	0	4330	4330
Pacific Northwest Laboratory	Richland, WA	0	3169	3169
Princeton Plasma Physics Laboratory	Princeton, NJ	0	559	559
Sandia National Laboratories, CA	San Diego, CA	0	4216	4216
Sandia National Laboratories, NM	Albuquerque, NM	0	4216	4216
Savannah River Ecology Laboratory	Aiken, SC			
Superconducting Super Collider Laboratory	Dallas, TX	20	0	20

Information obtained from the Office of Organization and Management, and the Office of Worker Transition

Table C-2. List of Elements in DOE Universe (valid Summer 1996)

DOE Headquarters			
Site	Employees		
	Federal	Contractor	Total
Chief Financial Officer	255	0	255
Civilian Radioactive Waste Management	221	0	221
Congressional & Intergovernment Affairs	103	0	103
Defense Programs	353	0	353
Economic Impact and Diversity	50	0	50
Energy Efficiency and Renewable Energy	560	0	560
Energy Information Administration	454	0	454
Energy Research	321	0	321
Environment, Safety, and Health	416	0	416
Environmental Management	702	0	702
Field Management	65	0	65
Fissile Materials Disposition	20	0	20
Fossil Energy	224	0	224

Information obtained from the Office of Organization and Management, and the Office of Worker Transition

Table C-2. List of Elements in DOE Universe (valid Summer 1996)

DOE Headquarters			
Site	Employees		
	Federal	Contractor	Total
General Counsel	195	0	195
Hearings and Appeals	69	0	69
Human Resources and Administration	859	0	859
Inspector General	325	0	325
Naval Reactors	56	0	56
Nonproliferation and National Security (CTA)	345	0	345
Nuclear Energy	143	0	143
Office of the Secretary	20	0	20
Policy, Planning, and Program Evaluation	185	0	185
Public and Consumer Affairs			
Quality Management	11	0	11
Science Education and Technical Information			
Secretary of Energy Advisory Board	4	0	4
Tech. Partnerships & Econ. Comp.			
Worker and Community Transition	16	0	16

Information obtained from the Office of Organization and Management, and the Office of Worker Transition

**Table C-3. Educational Institutions Providing
Technology-Supported Learning Opportunities**
(valid Summer 1996)

California State - Chico
Central Training Academy (DOE/NN)
Colorado State University
George Washington University
ICS Center for Degree Studies
Idaho State University
Kansas State University
National Technological University
New Mexico State University
New Mexico Tech
Oklahoma State University
Regents College of New York
Roane State University
Southern Methodist University
Stanford University
Texas Tech University
Thomas Edison State College
University of California - Davis
University of Colorado
University of Colorado - Denver
University of Idaho
University of Massachusetts - Dartmouth
University of Missouri
University of New Mexico
University of Phoenix
Walden University
Western Illinois University
Wright State University

Table C-4. Terrestrial Communications Capabilities (valid Summer 1996)

DOE Element	Internet Capabilities	Other Capabilities
DOE Headquarters		
Civilian Radioactive Waste Management	93% connectivity (485 employees)	
Congressional & Intergovernmental Affairs	100% connectivity (104 employees)	
Defense Programs	no data provided	
Environment, Safety and Health	90% connectivity	
Inspector General	100% connectivity (320 employees)	
Nonproliferation & National Security (Central Training Academy)	15% connected. Future equipment installation and expanded connectivity planned.	Fiber optic lines available as part of infrastructure; hardware to accommodate not yet on campus. Microwave dish capability-multi-bandwidth.
Field Organizations		
Albuquerque Operations Office	30% connected; not used for technology-supported learning	
Amarillo Area Office - Pantex Plant	20% connected; not used for technology-supported learning	Planned expansion of Internet and intranet-based delivery of non-critical training. Some fiber optic connectivity
Fernald Area Office	no data provided	
Grand Junction Project Office	30% connected; not used for technology-supported learning	Cable infrastructure can accommodate fiber optic technology.
Idaho Operations Office	no data provided	Fiber optic connectivity
Kansas City Area Office	30% connected	

Table C-4. Terrestrial Communications Capabilities (valid Summer 1996)

DOE Element	Internet Capabilities	Other Capabilities
Kansas City Plant	80% connected; not used for technology-supported learning	
Kirtland Area Office	80% connected; not used for technology-supported learning	Basic online training available on broadband network. One ITV classroom.
Nevada Operations Office	Some connectivity	
Oakland Operations Office		
Oak Ridge Operations Office	Routinely uses Internet for training activities & information.	
Office of Scientific & Technical Information	Some connectivity	Some fiber optic connectivity by August 1997.
Pittsburgh Energy Technology Center	no data provided	
Richland Operations Office	80% connectivity	Extensive WAN with coaxial cable and twisted pair cable in building; T1 and fiber optic lines to interconnect buildings.
Rocky Flats Field Office	100% connected; used for electronic mail	Broadband LAN connects buildings across site.
Savannah River Operations Office	90% connected; not available for training	Fiber optic-based wide-area ethernet data network with over 15,000 active connections. Broadband cable TV (CATV) network used to distribute NTU and other broadcasts. Planning to install wideband video system. Video training center.
Strategic Petroleum Reserve Project Office	Some connectivity	

Table C-4. Terrestrial Communications Capabilities (valid Summer 1996)

DOE Element	Internet Capabilities	Other Capabilities
Western Area Power Administration	85% connectivity (2,000 employees)	
Laboratories		
Brookhaven National Lab	Some connectivity	Fiber optic connectivity.
Fermi National Accelerator Lab	60% connected	Fiber optic connectivity.
Idaho National Engineering Lab	50% connected; some training delivery	Broadband network training. Fiber optic network links multiple locations.
Lawrence Berkeley National Lab	Some connectivity	Fiber optic connectivity.
Lawrence Livermore National Lab	75% connected (8,000 employees); WWW used for various short training courses	Broadband data network. 29-channel broadband cable network used primarily for education. Fiber optic connectivity.
Lawrence Livermore National Lab Nevada Test Site	70% connected (26 employees)	
Los Alamos National Lab	80% connected; electrical safety course available	Broadband data network. Broadband video network with 8 cable channels with one-touch interactivity. Fiber optic networks.
Oak Ridge National Lab	40% connected; some CBT/Internet use for delivering training	Broadband data network distributed via fiber optic network. Broadband video network with CATV network in 3 plants.
Sandia National Lab, NM	55% connected (6,000 employees); WWW used for internal advertising of training courses	Broadband data network gives access to WWW; use for training is very limited. Some fiber optic network connectivity.
Stanford Linear Accelerator Center	Some connectivity; WWW used for various short training courses	

Table C-5. Multimedia Capabilities (valid Summer 1996)

DOE Element	Current Capabilities
DOE Headquarters	
Civilian Radioactive Waste Management	CD-ROM
Congressional & Intergovernmental Affairs	no data provided
Defense Programs	CD-ROM; CBT; training room
Environment, Safety and Health	CD-ROM; training centers
Inspector General	CD-ROM capabilities available
Nonproliferation & National Security (Central Training Academy)	CBT capabilities available
Field Organizations	
Albuquerque Operations Office	LAN delivered CBT
Amarillo Area Office - Pantex Plant	5% of training available via CBT; 32 CBT courses available; 10 learning centers for CBT with 1-15 workstations for each center. Capability to edit and compress MPEG video and to master small-run CD-ROMs
Fernald Area Office	Developing CBT for general employee training
Grand Junction Project Office	Two CBT courses delivered via LAN; additional CBT products are planned. One classroom has 8 personal computer workstations - available for CBT training. Some video tapes available.
Idaho Operations Office	no data provided
Kansas City Area Office	19 multimedia workstations for CBT delivery - 4 of these stations have laser disc capabilities
Kansas City Plant	none

Table C-5. Multimedia Capabilities (valid Summer 1996)

DOE Element	Current Capabilities
Kirtland Area Office	CBT courseware; one learning center with 4 multimedia capable computer workstations
Nevada Operations Office	CD-ROM and video disc; 4 training centers
Oakland Operations Office	LAN-based CD-ROM; Standalone multimedia workstation
Oak Ridge Operations Office	CBT used for HR and technical training activities
Office of Scientific & Technical Information	CD-ROM; 1 training center
Pittsburgh Energy Technology Center	Off-the-shelf CBT for ADP courses
Richland Operations Office	CD-ROM; major CBT program
Rocky Flats Field Office	Masters CBT courseware on CD-ROM for transfer and export to other sites; dedicated CBT terminals to run courseware
Savannah River Operations Office	Limited CD-ROM server capability; CBT center; offers CBT version of GET
Strategic Petroleum Reserve Project Office	CD-ROM; 5 training centers; 4 classrooms with multimedia workstations and video capabilities
Western Area Power Administration	Planning for CD-ROM
Laboratories	
Brookhaven National Lab	CD-ROM; 4 training centers
Fermi National Accelerator Lab	CD-ROM and video disc
Idaho National Engineering Lab	Establishing 7 learning centers and will offer RADworker, electrical safety, and other high volume courses
Lawrence Berkeley National Lab	CD-ROM and video disc; 3 training centers
Lawrence Livermore National Lab	CD-ROM, MPEG, Quicktime encoding and multimedia delivery to desktop

Table C-5. Multimedia Capabilities (valid Summer 1996)

DOE Element	Current Capabilities
Lawrence Livermore National Lab - Nevada Site	CD-ROM
Los Alamos National Lab	CBT
Oak Ridge National Lab	
Sandia National Lab, NM	no data provided
Stanford Linear Accelerator Center	CD-ROM

Table C-6. Satellite Capabilities (valid Summer 1996)

DOE Element	Analog Signal		Digital Signal	Comments
	C-Band	Ku-Band		
DOE Headquarters				
Civilian Radioactive Waste Mgmt.			none	Analog uplink and downlink
Congressional & Intergovernmental	none	none	none	
Defense Programs				Access to Headquarters capabilities
Environment, Safety & Health	none	none	none	
Inspector General			none	Analog uplink and downlink with production studio
Nonproliferation & Nat. Security (Central Training Academy)	1 receiver	3 receivers and uplink	2 receivers and uplink	Full production studio; 20 one-touch systems throughout DOE complex
Field Organizations				
Albuquerque Operations Office	1 receiver	1 receiver	none	
Amarillo Area Office - Pantex Plant	1 receiver available; planning additional receiver dedicated to training	1 receiver available for receiving CTA courses; planning additional receiver	none	Expansion of downlink capabilities planned
Fernald Area Office				no data provided
Grand Junction Project Office	1 receiver	1 receiver	none	Downlink used to record broadcasts for development and training
Idaho Operations Office	2 receivers	2 receivers	none	
Kansas City Area Office	none	none	none	

Table C-6. Satellite Capabilities (valid Summer 1996)

DOE Element	Analog Signal		Digital Signal	Comments
	C-Band	Ku-Band		
Kansas City Plant	none	none	none	
Kirtland Area Office	none	none	none	
Nevada Operations Office				Satellite downlink and production studio
Oakland Operations Office				
Oak Ridge Operations Office	2 receivers	1 receiver		
Office of Sci. & Tech. Information				Satellite downlink
Pittsburgh Energy Tech Center				Uses satellite broadcasting and videos
Richland Operations Office	1 receiver leased	1 receiver leased	FTS2000 digital satellite compression feature video downlink at Patrol Training Academy for CTA courses	75-80 classes from University of New Mexico via interactive microwave
Rocky Flats Field Office	2 receivers	none	3 receivers	Has downlink to receive CTA broadcasts (FTS2000); Equipment being procured to receive NTU
Savannah River Operations Office			Receives & rebroadcasts NTU courses	21 digital, Ku, and C-band receivers DOE VSAT (receive video, 2-way audio) system installed
Strategic Petroleum Reserve Office				Satellite downlink receivers; four classrooms with satellite downlink. Also uses video.
Western Area Power Administration			Has digital satellite compression feature	Video production studio Downlink 1-2 "wildcard" training\education situations each week.

Table C-6. Satellite Capabilities (valid Summer 1996)

DOE Element	Analog Signal		Digital Signal	Comments
	C-Band	Ku-Band		
Laboratories				
Brookhaven National Lab				Satellite downlink and production studio
Fermi National Accelerator Lab	receiver	receiver		Production studio
Idaho National Engineering Lab	2 receivers	2 receivers	none	
Lawrence Berkeley National Lab				Has analog satellite downlink and uplink
Lawrence Livermore National Lab	3 receivers	3 receivers and uplink	12 receivers for NTU 2 receivers for CSU and CTA	Fiber optic connectivity; Complete television studio; digital video and digital editing capabilities
Lawrence Livermore National Lab - Nevada Site			none	Analog satellite downlink and uplink
Los Alamos National Lab	4 receivers and uplink capability via microwave	4 receivers and uplink capability via microwave	5 receivers for NTU uplink capability via microwave	Microwave network to University of NM; Full production studio; full television studio
Oak Ridge National Lab	2 receivers	1 receiver	1 receiver for NTU	Downlinks at Lockheed Martin Energy Systems Center for Continuing Education. Planning uplink through University of Tennessee. Professional video taping studio and broadcast facilities.
Sandia National Lab, NM	2 receivers	3 receivers	4 receivers	One dedicated satellite seminar classroom
Stanford Linear Accelerator Center				Analog receiver

Table C-7. Current Delivery Methods (valid Summer 1996)

DOE Element	On-the-Job or Other Training	Classroom	Desktop Video	Interactive Television	Multimedia/CBT	Internet
DOE Headquarters						
Civilian Radioactive Waste Management	-	90%	0	0	10%	0
Defense Programs	-	90%	0	0	10%	0
Environmental Management	-	95%	0	0	5%	0
Environment, Safety and Health	-	95%	0	2%	3%	0
Inspector General	-	98%	0	2%	0	0
Field Organizations						
Albuquerque Operations Office	-	95%	5%	0	0	0
Amarillo Area Office - Pantex Plant	40%	55%	0	0	5%	0
Morgantown Energy Technology Center	-	85%	0	1%	12%	2%
Nevada Operations Office	-	90%	0	5%	5%	0
Oakland Operations Office	-	95%	0	0	4%	1%
Oak Ridge Operations Office	-	95%	0	0	5%	0
Office of Scientific & Technical Information	-	100%	0	0	0	0
Ohio Field Office	-	98%	0	1%	1%	0

Table C-7. Current Delivery Methods (valid Summer 1996)

DOE Element	On-the-Job or Other Training	Classroom	Desktop Video	Interactive Television	Multimedia/CBT	Internet
Richland Operations Office	10%	60%	0	10%	10%	10%
Rocky Flats Field Office	-	80%	0	0	20%	0
Strategic Petroleum Reserve Project Office	-	94%	0	5%	0	1%
Western Area Power Administration	-	70%	25%	0	5% planned	0
Laboratories						
Brookhaven National Lab	15%	72%	0	5%	3%	1%
Fermi National Accelerator Lab	-	45%	10%	10%	5%	30%
Idaho National Engineering Lab	-	95%	0	0	5%	0
Lawrence Berkeley National Lab	-	100%	0	0	0	0
Average Percentage	3%	85%	3%	2%	5%	2%

21 responses out of 61 DOE elements identified = 34 percent of the DOE elements

21 responses out of 38 responding DOE elements = 55 percent of respondents

Appendix D

Information Systems Inventory

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Appendix D. Information Systems Inventory

The Information Systems Inventory identifies the primary information management systems that are being used to support DOE education and training processes. This inventory provides background information and highlights redundancies in the information systems used within the DOE training community.

This information system inventory was developed using a multi-step process. Participants in the first business case development workshop identified the information systems their organizations use in support of education and training processes. The training systems that were identified during the DOE Office of Human Resources SIM Initiative, but were not identified during the DOE Technology-Supported Learning initiative, were added to the inventory. Information system descriptions were collected through the use of a questionnaire completed by workshop participants. Phone interviews were held with Information Management points-of-contact to collect platform and user information.

The Department has at least 20 information systems that support training. These systems range from the mainframe-based Department Training Information System (DTIS) to spreadsheet data bases maintained at local program offices and field sites. Each of these systems was developed to meet specific user needs; however, all of these systems overlap in the types of information they provide. There is no single Departmentwide training information system. Several information systems are used across the Department to support training processes.

The Local Educational Administrative Requirements Network (LEARN) and System Management for Annual Requested Training (SMART) systems were developed as a result of the inadequacy of Headquarters' systems to meet the field's needs. Although LEARN and SMART are used by a number of DOE sites, each site has implemented a standalone version of these systems. These systems are not directly linked to each other or to other DOE training systems. The most recent system developed is the Clearinghouse for Training, Education and Development (CTED). The system is located on an Internet website and includes several information functions including the DOE Universal Catalog.

There is no information system (or combination of information systems) that provides access to aggregate DOE training information, making it impossible to electronically generate Departmentwide summaries for training statistics and program performance information. Running parallel systems requires duplicative manual re-keying of data reducing data integrity, increasing the potential for error, and increasing information systems costs across the Department.

The following sections describe the primary information systems that are used to support DOE education and training processes.

D.1 Departmental Training Systems

These information systems support more than one DOE program office or field location. Each of these information systems provides similar information. Table D-1 contains the names, user base, and the types of information stored in each information system.

D.2 Local Training Systems

These information systems are standalone, locally developed systems that support individual DOE locations. Each of these systems automates a portion of the local training process. Some of this information is also tracked in the Departmental information systems. Table D-2 contains the names, location, and the types of information stored in each local training information system.

D.3 Finance and Budgeting Systems

This type of information system was not the focus of this analysis, however several information systems that are used to process and track budget and cost information for the Department were identified. Table D-3 contains the names and the types of information stored in each finance and budget information system.

Table D-1. Departmental Training Information Systems

System Name	DOE Facility/Contract	Contacted	System Description	Platform
CTED Clearinghouse for Training, Education and Development	HQ-HR-31 Tanya Luckett 202-426-1516	Yes	Includes DOE Universal Catalog and a repository of study guides for Technical Qualifications Program.	World Wide Web Developed for entire DOE training community
DTIS Department Training Information System	HQ-HR-2 Bob Sottile 202-426-1538	Yes	Tracks scheduling of training classes; class registration; class rosters; reservation of funds for outside training opportunities; employee training history. Generates the DF3410 form.	Mainframe/mini-based Developed in house
DOE On-Track for Training	HQ-HR-2 Bob Sottile 202-426-1538	Yes	Tracks scheduling of training class; class registration; class rosters; reservation of funds for outside training opportunities; employee training history; position qualification requirements; employee qualifications; individual development plans (IDPs); training budgets; automated certificate generation; class attendance; equipment/room scheduling; instructor scheduling; curricula development.	LAN-based Commercial off-the-shelf
LEARN Local Educational Administrative Requirements Network	Savannah River Terry Frizell 803-725-2291	Yes	Tracks scheduling of training classes; class registration; class rosters; employee training history; position qualification requirements; employee qualifications; IDPs; training budget; automated certificate generation and class attendance. Generates the DF 3410 form.	Mac/PC-based standalone Developed in house
SMART System Management for Annual Requested Training	Savannah River Terry Frizell 803-725-2291	Yes	Network application used by employees to review and update their annual IDPs. Employees may request training and also update their Technical Qualification Program (TQP) records, if they participate in TQP.	PC-based standalone Developed in house
TQP Tracker Technical Qualifications Program Tracker	Savannah River Terry Frizell 803-725-2291	Yes	Tracks internal TQP participant status in the program; qualifications that must be met; and identifies equivalencies and exemptions by participant for each qualification standard competency.	Mac/PC-based standalone Developed in house
TRADE Training Resource and Data Exchange	ORISE Tina McKinley 423-576-3418	Yes	Both a human and computer network designed to share information across the DOE training complex. Variety of information sources supported by 12 DOE offices. Currently developing World Wide Web search engine that will support the universal course catalog.	World Wide Web Developed in house

Table D-2. Local Training Information Systems

System Name	DOE Facility/ Contract	Contacted	System Description	Platform
Training Room Reservations	Bonneville Power Admin Mary Zeiher 503-230-3487	Yes	Access data base program for training room scheduling	PC-based spreadsheet Developed in house
ATS Automated Training System	Bonneville Power Admin Mary Zeiher 503-230-3487	Yes	Tracks training records, training support and logistics information, and course numbers	LAN-based Developed in house
Training Instructor Tracking	Bonneville Power Admin Mary Zeiher 503-230-3487	Yes	Tracks course instructor information	LAN-based Developed in house
ITTS Internal Consulting Training and Tracking	Bonneville Power Admin Mary Zeiher 503-230-3487	Yes	Tracks time charged by employee	PC-based Commercial off -the-shelf
Training Registration System	Chicago Ops Office Regina Griswold 708-252-2151	Yes	Training registration and tracking for both centralized and decentralized training funds	LAN-based Developed in house
Training Register	Energy Efficiency & Renewable Energy Steve Von Vidal 202-586-2978	No	Automated training registration program	LAN-based Commercial off-the-shelf
SCEP Student Data base	Nevada Operations Office Alice White 702-295-0660	No	Co-operative education student program	PC-based File Maker Pro Commercial off-the-shelf
EBD Exam Bank Data Base	Rocky Flats Field Office Paul Bakke 303-966-7851	Yes	Provides test authoring, item banking, and test generation. Can generate up to four versions of a test and scramble items and/or answers.	PC-based standalone Commercial off-the-shelf

Table D-2. Local Training Information Systems

System Name	DOE Facility/ Contract	Contacted	System Description	Platform
TRAMS Training Requirements Authentications and Management System	Richland Operations Office Richard Self 509-372-2843	Yes	Track and identify employee training needs.	PC-based standalone Developed in house
TRENDS Training Requirements Employee Needs Development System	Savannah River Operations Office Terry Frizell 803-725-2291	Yes	Used to perform training needs analysis on location for the employee. It uses baseline data from previous position analyses to build a training profile that can then be customized to the employee.	Mac/PC-based standalone Developed in house
OTATS Office of Training Action Tracking System	Savannah River Operations Office Terry Frizell 803-725-2291	Yes	Schedule, track, and trend work processed by training office. Functions include full search capability by date, tracking number, subject, and assigned point-of-contact.	PC-based File Maker Pro Developed in house

Table D-3. Budgeting & Finance Information Systems

System Name	DOE Facility/Contract	Contacted	System Description	Platform
DISCAS Departmentalized Integrated Standardized Core Accounting System	Oak Ridge Operations Office Roy Settle 423-576-2126	Yes	Tracks actual cost expenditures	HP mainframe Developed in house
BEFS Budget Execution & Formulation System	Oak Ridge Operations Office Charlene Battiso 423-576-0633	Yes	Collects and reports budgets and costs by task. Accesses relevant Departmental systems and other sites financial contractor systems to establish a single source for conducting a wide variety of detail and summary level planning, budget and financial management functions. Tracks financial and budget data in terms of B&R, AOP, WBS, ADS, and TDS.	HP mainframe Developed in house
BTS Budget Tracking System	Rocky Flats Field Office Paul Bakke 303-966-7851	Yes	Monitors, tracks, and develops training budgets	PC-based standalone Developed in house

Appendix E

DLAST Methodology and Preliminary Results

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Appendix E. DLAST Methodology and Preliminary Results

E.1 DLAST Methodology

One of the primary objectives of the needs assessment process was to determine the extent of the cross-cutting education and training needs within the Department that could possibly be met using advanced training technologies. The Distance Learning Appropriateness Screening Tool (DLAST) was developed to estimate training needs, and to predict the effectiveness and applicability of the various types of advanced training technologies for delivering cross-cutting learning activities.

Two types of data about education and training were identified as vital to the needs assessment: demographics (e.g., information regarding the size, distribution across the complex, and nature of the intended audience for each projected need); and internal course attributes (e.g., type of learning and testing required, amount of media and hands-on experience required, amount of interactivity and individualization required, and risk if training was inadequate). The processes used to collect and analyze the data and an overview of the results are described in the following sections.

E.1.1 Demographic Data

Data was collected (from sources such as the Departmental Training Information System) regarding the following course demographic information: course length; the percentage of DOE Federal and contractor employees who need to take the course at some point in their careers; whether the course was an initial training or required annual, bi-annual, or tri-annual refreshing; and the percentage of students having to travel to attend the course. This information was entered into the DLAST and used to calculate preliminary data about Departmental needs in the areas of student training hours delivered/required, distribution of training needs across the Department, and levels of travel related to training.

Statistics were collected (from sources such as course catalogs) regarding the quantity and type of education and training currently being provided throughout the DOE complex. The DOE Universal Catalog was the primary source of information. The DOE Universal Catalog organizes course descriptions into 13 topical areas. Approximately 1,600 course descriptions were available. An analysis of the 13 topical areas resulted in the identification of seven areas where cross-cutting potential was most likely to occur. Six representative courses were selected from each of the seven topical areas. Several hundred additional course descriptions were randomly selected with no particular quantity being drawn from any one source or topical area.

During the second business case workshop, the participants reviewed 164 course descriptions (approximately 10 percent of the total courses found including duplicate courses) and sorted the courses into high-level categories of cross-cutting potential. Each course was rated as one of three levels: (A) training required for essentially all personnel, (B) training required for all employees who share a given job type or work function, and (C) training required for all

employees working at a particular type of facility. Training required for all personnel (level A) has the greatest potential for cross-cutting applicability.

Table E-1 at the end of this section offers a summary of the analysis of courses using the 13 topical areas from the DOE Universal Catalog. The table presents the number of courses selected (rated) in each area, the number of courses that were not rated, and the total number of course descriptions that were found for each topical area.

The table also provides the percentage of courses rated in each topical area based on the number of courses found, an estimated percentage of the total number of courses represented in a topical area, and an estimate of the maximum number of unique courses that exist for each topical area. The maximum number of unique courses in several cases was estimated to be less than the number found because of observed or suspected duplication. For example, of the 267 professional development courses found, only 133 represented unique courses. In other areas, it is assumed that there are significantly more courses being offered than were found (e.g., Engineering Sciences where only 10 courses were found, but three times that number are believed to exist.)

E.1.2 Course Characteristics Data

The 164 courses analyzed for demographic data were also subjected to a rating of the characteristics of the courses to determine their appropriateness for technology-supported learning. The following characteristics were used for the rating.

- Stability of the course content
- Learning outcomes to be achieved
- Amount of media required (i.e., audio, still graphics, full motion video, animation, etc.)
- Overall quality or fidelity level for the required media elements
- Amount of interactivity between students and with the instructor
- Amount of individualization needed in terms of feedback and branching through the course (as well as site specific content)
- Type of testing to be performed to confirm student comprehension
- Risks involved if the students did not fully learn the course content

A 10-point sliding scale was used to rate six of the characteristics, where a rating of 1 indicated a low need or weak relationship and 10 indicated a high need or strong relationship. The learning outcomes characteristic used an eight-level scale representing learning types with psychomotor at the low end and evaluation at the high end. The type of testing characteristic used a six-level scale ranging from recognition on the low end to performance on the high end.

E.2 DLAST Results

Using the estimates collected for both types of data (demographics and course characteristics), DLAST was designed to calculate, at a preliminary screening level, the relative appropriateness of each of the three major advanced training technologies (interactive television, multimedia, and Internet) for delivering cross-cutting courses. Weighted tables were developed that took the

course characteristic data and added to or subtracted from a score based for each media type. Depending on the three calculations, each media type was considered Excellent, Good, or Poor for each course.

Using these qualitative screening assessments, DLAST then made five preliminary recommendations for each course based on rules programmed in for five alternative scenarios for delivering courses. The first three scenarios included both Excellent and Good rated courses. The first scenario maximized the use of interactive television, the second maximized the use of multimedia, and the third maximized the use of high-speed networks. The final two scenarios considered only Excellent ratings. The fourth scenario maximized for interactive television, while the fifth maximized for multimedia. The tool was built such that other scenarios, adjustments, and variations could be configured through programming.

Tables E-2, E-3, and E-4 at the end of this section provide a summary of the DLAST results for each of the advanced training technology focuses (interactive television, multimedia, and Internet) and show which delivery method was rated Excellent, Good, or Poor for each DOE Universal Catalog topical area.

The DLAST results were preliminary in nature and were treated as projective rather than actual or definitive. DLAST was used to develop an overall picture of the education and training needs that might be addressed by technology-supported learning--especially estimates of the numbers of cross-cutting courses that might be delivered appropriately through each of the advanced training technologies. The results of the analysis provided a reasonable basis for creating alternatives that could be analyzed for costs and benefits.

DLAST was not used to make decisions about which courses should be converted to a technology-supported learning delivery method, or which method or combination of methods would be most appropriate. For each course being considered for technology-supported learning delivery, a detailed media/method selection analysis should be performed at the course objective level. Such analysis was found to be necessary by several organizations surveyed in the Benchmarking and Best Practices efforts. This analysis is also called for in the Systematic Approach to Training.

Table E-1. Summary of DLAST Demographic Data

DOE Universal Catalog Categories	Number of Courses in Each Category Rated Using DLAST	Number of Courses in Each Category Not Rated	Total Number of Courses Found	Percentage Rated of Courses Found	Estimated % of Courses Found From Total Courses Available (rated + not rated)*	Estimated Number of Unique Courses Available in Each Category
Administration, Orientation, & Awareness (ADM)	20	135	155	13%	100%	155
Engineering Sciences (ENG)	9	1	10	90%	30%	33
Environmental (ENV)	22	32	54	41%	80%	68
Management (MGT)	23	123	146	16%	100%	146
Nuclear Theory Processes & Systems (NTP)	3	1	4	75%	10%	40
Nuclear Safety (NUS)	8	1	9	89%	10%	90
Nuclear Weapons (NUW)	2	1	3	67%	10%	30
Oversight (OVR)	16	303	319	5%	500%	64
Professional Development (PRO)	15	252	267	6%	200%	133
Physical Sciences & Mathematics (PSM)	4	1	5	80%	5%	100
Safeguards & Security (S&S)	19	200	219	9%	100%	219
Safety & Health (SAF)	18	392	410	4%	400%	102
Technology Transfer (TTR)	5	1	6	83%	100%	6
Total Crosscutting Courses	1,607			1186		

*Percentages greater than 100 indicate the existence of duplicate courses.

Table E-2. DLAST Results With Focus on Interactive Television (ITV)

<u>Topic</u>	<u>No. Rated</u>	<u>Excellent</u>	<u>% Excellent</u>	<u>Good</u>	<u>% Good</u>	<u>Poor</u>	<u>% Poor</u>
ADM	20	7	35%	11	55%	2	10%
ENG	9	4	44%	5	56%	0	0%
ENV	22	14	64%	6	27%	2	9%
MGT	23	11	48%	12	52%	0	0%
NTP	3	0	0%	2	67%	1	33%
NUS	8	0	0%	5	63%	3	38%
NUW	2	2	100%	0	0%	0	0%
OVR	16	6	38%	10	63%	0	0%
PRO	15	5	33%	4	27%	6	40%
PSM	4	4	100%	0	0%	0	0%
S&S	19	8	42%	9	47%	2	11%
SAF	18	12	67%	6	33%	0	0%
TTR	5	4	80%	1	20%	0	0%
Total	164	77	47%	71	43%	16	10%
Alt 1		148	90%				
Alt 2		0	0%				
Alt 3		3	2%				
Alt 4		77	47%				
Alt 5		4	2%				

- Alt 1 Do as much as possible (excellent and good) via ITV, then MM and Net
 Alt 2 Do as much as possible (excellent and good) via MM, then Net and ITV
 Alt 3 Do as much as possible (excellent and good) via Net, then MM and ITV
 Alt 4 Do excellent only, start with ITV, then MM, and finally Net
 Alt 5 Do excellent only, start with MM, then Net, and finally ITV

Table E-3. DLAST Results With Focus on Multimedia

<u>Topic</u>	<u>No. Rated</u>	<u>Excellent</u>	<u>% Excellent</u>	<u>Good</u>	<u>% Good</u>	<u>Poor</u>	<u>% Poor</u>
ADM	20	10	50%	9	45%	1	5%
ENG	9	9	100%	0	0%	0	0%
ENV	22	18	82%	3	14%	1	5%
MGT	23	15	65%	8	35%	0	0%
NTP	3	2	67%	1	33%	0	0%
NUS	8	5	63%	3	38%	0	0%
NUW	2	2	100%	0	0%	0	0%
OVR	16	11	69%	5	31%	0	0%
PRO	15	5	33%	7	47%	3	20%
PSM	4	4	100%	0	0%	0	0%
S&S	19	14	74%	5	26%	0	0%
SAF	18	16	89%	2	11%	0	0%
TTR	5	5	100%	0	0%	0	0%
Total	164	116	71%	43	26%	5	3%
Alt 1		11	7%				
Alt 2		159	97%				
Alt 3		102	62%				
Alt 4		43	26%				
Alt 5		116	71%				

- Alt 1 Do as much as possible (excellent and good) via ITV, then MM and Net
 Alt 2 Do as much as possible (excellent and good) via MM, then Net and ITV
 Alt 3 Do as much as possible (excellent and good) via Net, then MM and ITV
 Alt 4 Do excellent only, start with ITV, then MM, and finally Net
 Alt 5 Do excellent only, start with MM, then Net, and finally ITV

Table E-4. DLAST Results With Focus on Internet/High-Speed Networks

<u>Topic</u>	<u>No. Rated</u>	<u>Excellent</u>	<u>% Excellent</u>	<u>Good</u>	<u>% Good</u>	<u>Poor</u>	<u>% Poor</u>
ADM	20	3	15%	3	15%	14	70%
ENG	9	0	0%	4	44%	5	56%
ENV	22	8	36%	3	14%	11	50%
MGT	23	1	4%	4	17%	18	78%
NTP	3	0	0%	0	0%	3	100%
NUS	8	0	0%	0	0%	8	100%
NUW	2	0	0%	1	50%	1	50%
OVR	16	1	6%	3	19%	12	75%
PRO	15	1	7%	1	7%	13	87%
PSM	4	0	0%	4	100%	0	0%
S&S	19	1	5%	4	21%	14	74%
SAF	18	3	17%	6	33%	9	50%
TTR	5	1	20%	2	40%	2	40%
Total	164	19	12%	35	21%	110	67%
Alt 1		0	0%				
Alt 2		0	0%				
Alt 3		54	33%				
Alt 4		0	0%				
Alt 5		0	0%				

Alt 1 Do as much as possible (excellent and good) via ITV, then MM and Net
 Alt 2 Do as much as possible (excellent and good) via MM, then Net and ITV
 Alt 3 Do as much as possible (excellent and good) via Net, then MM and ITV
 Alt 4 Do excellent only, start with ITV, then MM, and finally Net
 Alt 5 Do excellent only, start with MM, then Net, and finally ITV

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Appendix F

Business Case Alternatives A, B, and C

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Appendix F. Business Case Alternatives A, B, and C

This appendix provides a summary of the business case alternatives A, B, and C developed to address the Departmentwide need to identify cost-effective and efficient delivery methods for cross-cutting education and training learning activities to geographically dispersed students with a reduced dependency on travel. The alternatives represent different technical solutions for achieving DOE technology-supported learning goals using a corporate approach. These alternatives present options for expanding existing technology-supported learning capabilities and for converting traditional lecture-based and self-study courses and materials into advanced training technology formats.

F.1 Focus on Interactive Television (Alternative A)

F.1.1 Description

Based on media suitability characteristics derived from the application of the Distance Learning Appropriateness Screening Tool (DLAST), the goal projected for alternative A is to deliver a minimum of 150 cross-cutting learning activities using the following delivery technology mix:

- 75 (50 percent) via interactive television (ITV)
- 45 (30 percent) via multimedia
- 30 (20 percent) via Internet

The remaining learning activities, not delivered through advanced training technologies, are assumed to be delivered through traditional classroom or self-study methods.

Interactive television was selected as the focus for alternative A for the following reasons.

- Interactive television has a high level of maturity relative to multimedia and Internet technology.
- The DOE complex already has a well-established base of interactive television facilities. Approximately 26 additional downlinks are required to bring the Department to 93 percent coverage (measured by employees with access within their organization or site).
- The results of the initial application of DLAST indicate that of the 164 courses screened, interactive television is an excellent delivery method for 47 percent of the courses.

F.1.2 Approach for Meeting Training Needs

A 5-year phased approach is assumed for the implementation of alternative A starting in fiscal year 1998. This approach encompasses learning activity development and delivery, technology infrastructure acquisition, and organizational changes.

In the short term, both analog and digital satellite formats would be needed to accommodate current capabilities. Some DOE sites have analog and some have digital capabilities. Also, some sites have fixed dishes and some have steerable dishes. The long-term solution is to move toward a fully compatible, digital capability throughout the Department.

Establishment of partnering agreements to deliver education and training learning activities is an aspect of this alternative that has not been fully explored. Many full-service educational institutions, tele-education, and tele-training companies (such as Wescott Communications, Elkins Interactive, and IDTN) provide complete production and uplink services or some part of those services. The Government Alliance for Training and Education (GATE) successfully completed a multi-agency partnering pilot project that used interactive television to deliver ethics training to 7,000 federal employees.

The alternative A delivery method mix of learning activities for fiscal years 1998 through 2002 is shown in table F-1 at the end of this section. It is assumed that each learning activity will be delivered at a frequency of at least twice per year (initial) and possibly several times a year depending on demand for refresher training.

F.1.3 Platform Descriptions

Interactive Television. The interactive television platform will provide an appropriate infrastructure for the delivery of interactive cross-cutting education and training learning activities via satellite to remote locations. The platform for the first 3 years will be a satellite system that is compatible with the system in operation at the Central Training Academy (CTA) located at DOE facilities in Albuquerque, New Mexico. Compressed digital video transmission will be used to satisfy one-way video requirements. This transmission will be supported by terrestrial two-way audio and viewer response systems for student-instructor interactivity.

The interactive television satellite platform will consist of three basic components: broadcast studio; uplink-downlink capabilities; and receive site capabilities.

- A fully operational broadcast studio is located at CTA. It is assumed that this will be the primary DOE studio. Partnering agreements with educational, Government, and commercial vendors will be explored for potential shared use of other studios.
- The CTA satellite uplink consists of a transmission dish along with encoding hardware. It transmits one channel of live or recorded instruction to a satellite in geosynchronous orbit. Partnering agreements with educational, Government, and commercial vendors will be explored for potential shared use of other uplink capabilities.
- Each downlink will consist of a receive-only satellite dish and an integrated receiver/decoder. The Department already has 23 sites with satellite downlink capabilities that provide one-way video with two-way audio and one-way data.

- Each receive site will include, but not be limited to, television monitors, a viewer response system, video cassette recorder(s), and associated components.

Compressed video teleconferencing services (CVTS) and desktop video-conferencing will serve as secondary interactive television systems.

- Compressed video teleconferencing services offer two-way video and two-way audio. Many sites already have compressed video teleconferencing capabilities that could be used for training delivery.
- Desktop video provides two-way video with two-way audio and data. As a training delivery method this technology provides point-to-point connection that is ideal for remote, one-on-one instructor/student training. The most common DOE platform for desktop video is an Intel-based personal computer.

Multimedia. Ideally, courseware could be obtained/developed that will run on Windows-based personal computers, Macintosh, and Unix platforms with multimedia equipment. For this business case, it is assumed that a standardized platform will be necessary to ensure that cross-cutting CBT courseware can be delivered at all sites. For the cost analysis, an Intel-based personal computer is assumed to be the standard platform for multimedia delivery. A more detailed explanation of this platform is provided in alternative B (section F.2.3).

Internet. No standard requirement has been identified for Internet (NET)-based training except that it should not be DOS-based. The standardization of browsers and plug-ins is considered more essential.

F.1.4 Technology Acquisition

The following is a phased approach for the acquisition of the technology needed to successfully implement alternative A. Also provided are organizational issues, such as the establishment of partnering agreements, that would support the technical implementation plan.

Fiscal Year 1997 (not included in the analysis of benefits and costs)

- ITV: Install one uplink site at the Savannah River Operations Office as part of an arrangement negotiated with the National Technological University. Install five downlink sites.
- MM: Establish standards for formats, hardware, and authoring tools. Research/buy existing learning activities to meet current needs where possible.

Fiscal Year 1998

- ITV: Upgrade the infrastructure and install 25 additional downlink sites to service 90 percent of the DOE population. Establish new and expand existing partnering agreements for additional uplink capabilities.
- MM: Establish 50 learning centers with a minimum of 6 multimedia workstations in each center and distribute throughout the DOE complex. Expand courseware distribution/production capabilities.

Fiscal Year 1999

- ITV: Upgrade infrastructure by adding integrated receiver/decoders and site controllers to increase the number of learning activities that can be received from the satellite and add keypads and training space to increase student capacity. Establish partnering agreements for development and delivery of learning activities.
- MM: Establish 25 learning centers with a minimum of 6 multimedia workstations in each center and distribute throughout the DOE complex. Expand courseware distribution/production capabilities.
- NET: Achieve 80 percent connectivity of all sites across the DOE complex. It is assumed that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 2000

- ITV: Continue existing partnering agreements and add new partnering agreements as needed.
- MM: Establish 25 additional learning centers with a minimum of 6 multimedia workstations in each center and distribute throughout the DOE complex. Expand courseware distribution/production capabilities.
- NET: Achieve 100 percent connectivity of all sites. It is assumed that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 2001

- ITV: Minimal additional acquisition of technology. Continue existing partnering agreements and add new partnering agreements as needed.
- MM: Accelerate production of courseware and establish partnering agreements.

NET: Upgrade networks to provide Internet access to all desktops. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 2002

ITV: Minimal additional acquisition of technology.

MM: Minimal additional acquisition of technology.

NET: Upgrade desktop computers to support Internet access, where needed. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Table F-1. Focus on Interactive Television (Alternative A)

	Year 1 - 1998	Year 2 - 1999	Year 3 - 2000	Year 4 - 2001	Year 5 - 2002	Totals for Methods
ITV Goal = 50% of courses appropriate for TSL delivery 1,835 average students/course each year	Install 25 additional downlink sites. Establish uplink partnering agreements.	Upgrade infrastructure. Establish development and delivery partnering agreements.	Expand partnering agreements.	Minimal acquisition of technology.	Minimal acquisition of technology.	
	Convert 15 courses	Convert 15 courses	Convert 15 courses	Convert 15 courses	Convert 15 courses	75 courses converted
	27,525 potential students	27,525 potential students	27,525 potential students	27,525 potential students	27,525 potential students	137,625 potential students
MM Goal = 30% of courses appropriate for TSL delivery 2,560 average students/course each year	Establish 50 learning centers with at least 6 multimedia workstations each.	Establish 25 learning centers with at least 6 multimedia workstations each.	Establish 25 learning centers with at least 6 multimedia workstations each.	Expand courseware production and distribution capabilities.	Minimal acquisition of technology.	
	Convert 7 courses. Buy additional existing courses.	Convert 7 courses	Convert 10 courses	Convert 10 courses	Convert 11 courses	45 courses converted
	17,920 potential students	17,920 potential students	25,600 potential students	25,600 potential students	28,160 potential students	115,200 potential students
Internet Goal = 20% of courses appropriate for TSL delivery 1,764 average students/course each year		Achieve 80% connectivity across DOE complex.	Achieve 100% connectivity across DOE complex.	Upgrade networks to provide Internet access to all desktops.	Upgrade desktop computers to support Internet access where necessary.	
		Convert 6 courses	Convert 8 courses	Convert 8 courses	Convert 8 courses	30 courses converted
		10,584 potential students	14,112 potential students	14,112 potential students	14,112 potential students	52,920 potential students
Totals for Each Year	22 courses converted	28 courses converted	33 courses converted	33 courses converted	34 courses converted	150 courses converted

F.2 Focus on Multimedia (Alternative B)

F.2.1 Description

Based on media suitability characteristics derived from the application of the Distance Learning Appropriateness Screening Tool (DLAST), the goal for alternative B is to deliver a minimum of 150 cross-cutting learning activities using the following delivery technology mix:

- 19 (13 percent) via interactive television
- 110 (73 percent) via multimedia
- 21 (14 percent) via Internet

The remaining learning activities, not delivered through advanced training technologies, are assumed to be delivered through traditional classroom or self-study methods.

Multimedia was selected as the focus for alternative B for the following reasons:

- Multimedia delivery has the advantage of always being available for students (on-demand training) and is highly interactive and self-paced.
- Cost savings from multimedia can be realized quickly and can be substantiated across the entire complex.
- Multimedia courseware can be developed by existing contractors or closely associated vendors already in place. These groups are capable and familiar with the needs of such learning activities.
- Generic courseware is widely available from commercial vendors.
- The results of the initial application of DLAST indicate that of the 164 courses screened, multimedia is an excellent delivery method for 71 percent of the courses.
- Multimedia learning centers and delivery hardware are in place at several DOE contractor locations. The following list (comprehensive list not available) identifies some of the known sites where existing multimedia learning centers and hardware are dedicated to education and training delivery.

Fernald - 25 systems

Hanford - 3 large learning centers; 20 systems

Idaho National Engineering Lab - approximately 6 learning centers; 20 systems

Lawrence Livermore National Lab (number of systems unknown)

Los Alamos National Lab (number of systems unknown)

Mound - 10 systems

Nevada Operations Office (number of systems unknown)

Oak Ridge (number of systems unknown)

Rocky Flats - 20 systems
Sandia National Lab (number of systems unknown)
Savannah River - 8 learning centers
West Valley - 6 systems

F.2.2 Approach for Meeting Training Needs

A 5-year phased approach is assumed for the implementation of alternative B starting in fiscal year 1998. This approach encompasses learning activity development and delivery, technology infrastructure acquisition, and organizational changes.

To enable widespread implementation of multimedia delivery for cross-cutting education and training learning activities as proposed in this alternative, a set of standards will need to be established in fiscal year 1997. A team of subject matter experts would be chartered to evaluate and adopt appropriate standards. One multimedia delivery hardware standard that will be considered has been proposed by the TRADE Special Interest Group for Advanced Training Technologies (SIGATT). The standards will evolve over the course of the 5-year implementation approach and would be reviewed and upgraded systematically to maximize utility, quality of training, and compatibility of courseware.

The expansion of existing and the acquisition of additional multimedia learning centers are important elements of this alternative. It is estimated that approximately 1,200 multimedia-equipped computer workstations would be needed in 200 learning centers across the Department by the year 2002 to accommodate the training requirements established in this alternative. Each learning center would contain a minimum of six multimedia-equipped computer workstations. Of that number, approximately 900 would need to be acquired in the first 3 years of the implementation plan. During the last 2 years, the emphasis will begin to shift from adding more multimedia-equipped computers to learning centers to upgrading individual workstations. It is assumed that much of this upgrading will occur at an organizational level that is independent of education and training budgets. Organizations will naturally upgrade to take advantage of emerging technologies and to replace obsolete equipment. Guidelines will be used in procurement systems to ensure compatibility is maintained.

Establishment of partnering agreements to develop and deliver education and training learning activities is a significant aspect of this alternative that has not been fully explored. One potential partnering opportunity is with the Federal Aviation Administration, which has extensive experience in CBT courseware development.

The alternative B delivery method mix of learning activities for fiscal years 1998 through 2002 is shown in table F-2 at the end of this section. To maximize effective use of multimedia, it is assumed that learning activities developed apply to a large population (greater than 500) and have frequent refresher cycles (1-2 years).

F.2.3 Platform Descriptions

Interactive Television. In the short term, both analog and digital satellite formats would be needed to accommodate current capabilities. The long-term solution is to move toward a fully compatible, digital capability throughout the Department. The technology for the first 3 years would be a Central Training Academy (CTA)-compatible satellite system with compressed video teleconferencing services (CVTS) and desktop video-conferencing as secondary interactive television delivery systems. A more detailed explanation of this platform is provided in alternative A (section F.1.3).

Multimedia. The multimedia/CBT delivery platform includes a personal computer, digital audio, compact disc read-only memory (CD-ROM), color monitor, high resolution graphics, and a touch screen (optional). For the cost analysis, an Intel-based personal computer is assumed to be the standard platform for multimedia delivery.

The multimedia/CBT courseware development platform includes authoring software and other development software that enhances courseware development and reduces programming time. Ideally, courseware could be obtained/developed that will run on Windows-based personal computers, Macintosh, and Unix platforms with multimedia equipment. A standardized platform may be a key element to ensure that cross-cutting CBT courseware can be delivered at all sites. If a single platform is required, it will most likely be an Intel-based Windows platform.

The types of multimedia vary in complexity and length of time to develop from simple hypertext systems to elaborate model-based simulations. The following multimedia types were considered for this alternative.

- Slide shows and linear CBT
- Drill and practice
- Emersion technology
- Hypertext and branching CBT
- Canned simulations
- Free-play simulations
- Virtual reality

Learning activity conversion to a specific type of multimedia needs to be evaluated on a case-by-case basis. Factors to consider include the stability of the content, potential complexity, the amount of video/graphics, the amount of interactivity, and other media selection criteria as identified in the DLAST. The estimated average labor hours to build learning activities range from less than 100 hours per student contact hour for hypertext to as much as 1,000 hours for interactive simulations and virtual reality. Using an average labor rate of \$50/hour, these labor hours represent a range of less than \$5,000/hour for simple hypertext up to \$50,000/hour for complex simulations. Many sources reporting multimedia development data indicate that they expect their costs to decrease by as much as 20 percent once their development experience with the medium matures.

Internet. No standard requirement has been identified for Internet (NET)-based training except that it should not be DOS-based. The standardization of browsers and plug-ins is considered more essential.

F.2.4 Technology Acquisition

The following is a phased approach for the acquisition of the technology needed to successfully implement alternative B. Also provided are organizational issues, such as the establishment of partnering agreements, that would support the technical implementation plan.

Fiscal Year 1997 (not included in the analysis of benefits and costs)

- ITV: Install one uplink site at the Savannah River Operations Office as part of an arrangement negotiated with the National Technological University. Install five downlink sites.
- MM: Establish standard hardware platform. Survey all sites for present capability and current assets. Identify sites performing courseware development and catalog their capabilities. Align all sites presently using multimedia to the coordination of learning activity development and deployment.

Fiscal Year 1998

- ITV: Install 20 downlink sites. Upgrade infrastructure by adding integrated receiver/decoders and site controllers to increase the number of learning activities that can be received from the satellite and add keypads and training space to increase student capacity. Begin to explore partnering opportunities for additional uplink capabilities.
- MM: Establish 100 learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center. Solicit existing courseware from all DOE sites. Identify subject matter experts and establish courseware development and delivery method Centers of Excellence.

Fiscal Year 1999

- ITV: Upgrade infrastructure by adding integrated receiver/decoders and site controllers to increase the number of learning activities that can be received from the satellite and add keypads and training space to increase student capacity. Establish partnering agreements for interactive television development and delivery.
- MM: Establish 50 learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center.

NET: Achieve 80 percent connectivity of all sites across the DOE complex. It is assumed that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 2000

ITV: Upgrade infrastructure by adding integrated receiver/decoders and site controllers to increase the number of learning activities that can be received from the satellite and add keypads and training space to increase student capacity. Evaluate existing partnering agreements and add new partnering agreements as needed.

MM: Establish 50 learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center. Begin upgrading individual workstations. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

NET: Achieve 100 percent connectivity of all sites. It is assumed that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives. Purchase site licenses for browser software taking advantage of Departmentwide purchasing agreements for economies of scale.

Fiscal Year 2001

ITV: Minimal additional acquisition of technology. Evaluate existing partnering agreements and add new partnering agreements as needed.

MM: Continue to upgrade individual workstations. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

NET: Upgrade networks to provide Internet access to all desktops. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 2002

ITV: Minimal additional acquisition of technology. Significant vendor interest should greatly improve opportunities to purchase vendor-produced courseware.

- MM: Minimal additional acquisition of technology. Anticipate that individual workstation platform upgrades will be funded by each site/organization to meet planned populations and delivery demand. Significant vendor interest should greatly improve opportunities to purchase vendor-produced courseware.
- NET: Upgrade desktop computers as needed to support Internet access. Anticipate that individual workstation platform upgrades will be funded by each site/organization to meet planned populations and delivery demand.

Table F-2. Focus on Multimedia (Alternative B)

	Year 1 - 1998	Year 2 - 1999	Year 3 - 2000	Year 4 - 2001	Year 5 - 2002	Totals for Methods
ITV Goal = 13% of courses appropriate for TSL delivery 1,835 average students/course each year	Install 20 downlinks. Upgrade infrastructure. Explore uplink partnering agreements.	Upgrade infrastructure. Establish partnering agreements.	Upgrade infrastructure. Add partnering agreements.	Minimal acquisition of technology.	Minimal acquisition of technology. Significant vendor courseware.	
	Convert 3 courses	Convert 4 courses	Convert 4 courses	Convert 4 courses	Convert 4 courses	19 courses converted
	5,505 potential students	7,340 potential students	7,340 potential students	7,340 potential students	7,340 potential students	34,865 potential students
MM Goal = 73% of courses appropriate for TSL delivery 2,560 average students/course each year	Establish 100 learning centers with at least 6 multimedia workstations each. Establish Centers of Excellence.	Add 50 learning centers with at least 6 multimedia workstations each.	Add 50 learning centers with at least 6 multimedia workstations each. Begin upgrading individual workstations.	Upgrade individual workstations.	Minimal acquisition of technology. Significant vendor courseware.	
	Convert 15 courses	Convert 20 courses	Convert 25 courses	Convert 25 courses	Convert 25 courses	110 courses converted
	38,400 potential students	51,200 potential students	64,000 potential students	64,000 potential students	64,000 potential students	281,600 potential students
Internet Goal = 14% of courses appropriate for TSL delivery 1,764 average students/course each year		Achieve 80% connectivity across DOE complex.	Achieve 100% connectivity across DOE complex. Purchase site licenses for browser software.	Upgrade networks to provide Internet access to all desktops	Upgrade desktop computers to support Internet access where necessary	
		Convert 4 courses	Convert 5 courses	Convert 5 courses	Convert 7 courses	21 courses converted
		7,056 potential students	8,820 potential students	8,820 potential students	12,348 potential students	37,044 potential students
Totals for Each Year	18 courses converted	28 courses converted	34 courses converted	34 courses converted	36 courses converted	150 courses converted

F.3 Focus on High-Speed Networks (Alternative C)

F.3.1 Description

Based on media suitability characteristics derived from the application of the Distance Learning Appropriateness Screening Tool (DLAST), the goal for alternative C is to deliver a minimum of 150 cross-cutting learning activities using the following delivery technology mix:

- 19 (13 percent) via interactive television
- 110 (73 percent) via multimedia
- 21 (14 percent) via Internet

The remaining learning activities, not delivered through advanced training technologies, are assumed to be delivered through traditional classroom and self-study methods.

High-speed networks were selected as the focus for alternative C for the following reasons:

- High-speed network delivery has the advantage of always being available for students (on-demand training).
- Courseware development can be done by existing contractors or closely associated vendors already in place. These groups are capable and familiar with the needs of such learning activities.
- As high-speed network technology matures, increased bandwidth will enable the seamless distribution of both multimedia and Internet courseware via high-speed networks.
- The results of the initial application of DLAST indicate that of the 164 courses screened, a combination of multimedia and Internet are an excellent delivery method for 83 percent of the courses.

F.3.2 Approach for Meeting Training Needs

A 5-year phased approach is assumed for implementation of alternative C starting in fiscal year 1998. This approach encompasses learning activity development and delivery, technology infrastructure acquisition, and organizational changes.

This alternative is very similar to alternative B, which focuses on the implementation of multimedia delivery methods. The primary difference between the two alternatives is the almost seamless merging of multimedia and Internet to high-speed network delivery in the fourth and fifth years of the implementation plan. Even some of the learning activities delivered via interactive television could be converted for delivery via high-speed network. For this alternative to be viable, it is assumed that as high-speed network technology matures, DOE organizations and sites will upgrade their networks and install fiber optic cable. As bandwidth increases, the use of high-speed networks as the "ultimate" delivery method becomes a reasonable option.

Standards and technologies for high-speed networks are evolving. This business case assumes, for the purpose of doing an analysis of benefits and costs, that fiber-optic cable is installed at each site up to the final nodes before distribution to the desktop. The final distribution network is assumed to be an Ethernet system.

While technology-supported learning is a good application of high-speed networks, an assumption has been made in this business case that technology-supported learning on its own does not provide adequate justification for installation of high-speed networks where they presently do not exist. It assumes that the need for high-speed networks will have other drivers in addition to technology-supported learning for justifying the investment.

Some sites in the DOE complex may not have access to a high-speed network backbone. Therefore, it would not be feasible to install such a network at those sites. Other forms of technology-supported learning (e.g., interactive television, multimedia/CBT, and low-speed Internet) would continue to be used at these sites.

Establishment of partnering agreements to deliver education and training learning activities is an aspect of this alternative that has not been fully explored.

The alternative C delivery method mix of learning activities for fiscal years 1998 through 2002 is shown in table F-3 at the end of this section.

F.3.3 Platform Descriptions

Interactive Television. In the short term, both analog and digital satellite formats would be needed to accommodate current capabilities. The long-term solution is to move toward a fully compatible, digital capability throughout the Department. The technology for the first 3 years would be a Central Training Academy (CTA)-compatible satellite system with compressed video teleconferencing services (CVTS) and desktop video-conferencing as secondary interactive television delivery systems. A more detailed explanation of this platform is provided in alternative A (section F.1.3).

Multimedia. Ideally, courseware could be obtained/developed that will run on Windows-based personal computers, Macintosh, and Unix platforms with multimedia equipment. A standardized platform may be a key element to ensure that cross-cutting CBT courseware can be delivered at all sites. For the cost analysis, an Intel-based personal computer is assumed to be the standard platform for multimedia delivery. A more detailed explanation of this platform is provided in alternative B (section F.2.3).

Internet. No standard requirement has been identified for Internet-based training except that it should not be DOS-based. The standardization of browsers and plug-ins are considered more essential.

The following types of Internet World Wide Web (WWW) pages are considered appropriate for delivery of education and training learning activities.

- Static Web pages are best for relatively low technology applications that are low in cost to convert, such as study guides or textbooks. Examples of appropriate types of training include slide shows and linear CBT, canned simulations, hypertext and branching CBT, and text-only materials.
- Dynamic Web pages are best for interactive applications such as testing, practice, and data base lookup applications. Examples of appropriate types of training include server-based common gateway interface scripted, imbedded JAVA or shockwave applets/scripts, drill and practice, and free-play simulations.

F.3.4 Technology Acquisition

The following is a phased approach for the acquisition of the technology needed to successfully implement alternative C. Also provided are organizational issues, such as the establishment of partnering agreements, that would support the technical implementation plan.

Fiscal Year 1997 (not included in the analysis of benefits and costs)

- ITV: Install one uplink site at the Savannah River Operations Office as part of an arrangement negotiated with the National Technological University. Install five downlink sites.
- MM: Establish standard hardware platform. Survey all sites for present capability and current assets. Identify sites performing courseware development and catalog their capabilities. Align all sites presently using multimedia to the coordination of learning activity development and deployment.

Fiscal Year 1998

- ITV: Install 20 downlink sites. Upgrade infrastructure by adding integrated receiver/decoders and site controllers to increase the number of learning activities that can be received from the satellite and add keypads and training space to increase student capacity. Begin to explore partnering opportunities for additional uplink capabilities.
- MM: Establish 100 learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center. Solicit existing courseware from all DOE sites. Identify subject matter experts and establish courseware development and delivery method Centers of Excellence.
- NET: Establish standards for the WWW browser software. Adopt standards for the hypertext markup language (HTML) formats used within the DOE complex. Achieve 80 percent Internet connectivity across the DOE complex. It is assumed that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 1999

- ITV: Upgrade infrastructure by adding integrated receiver/decoders and site controllers to increase the number of learning activities that can be received from the satellite and add keypads and training space to increase student capacity. Establish partnering agreements for delivery of learning activities.
- MM: Establish 50 learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center.
- NET: Achieve 100 percent connectivity of all sites across the DOE complex. It is assumed that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives. Purchase site licenses for browser software, including plug-ins necessary to deliver CBT/interactive television learning activities.

Fiscal Year 2000

- ITV: Upgrade network infrastructure. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.
- MM: Establish 50 learning centers throughout the DOE complex. Acquire and install a minimum of six multimedia workstations in each learning center. Begin upgrading individual workstations. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.
- NET: Purchase and install network upgrades at each site where necessary to provide high-speed digital transmission. It is assumed that this upgrade will be achieved through other DOE-wide or organizational level telecommunications enhancement initiatives.

Fiscal Year 2001

- ITV: Establish bridges to channel interactive television broadcast to the desktop.
- MM: Merge multimedia delivery with Internet capabilities and deliver learning activities via CD-ROM or the high-speed network.
- NET: Begin delivery of CBT learning activities via Internet on the high-speed network.

Fiscal Year 2002

- ITV: Convert some interactive television for delivery via high-speed network and merge with Internet capabilities.
- MM: Continue to merge multimedia delivery with Internet capabilities and deliver learning activities via CD-ROM or the high-speed network.
- NET: Begin delivery of interactive television/video via Internet on the high-speed network.

Table F-3. Focus on High-Speed Networks (Alternative C)

	Year 1 - 1998	Year 2 - 1999	Year 3 - 2000	Year 4 - 2001	Year 5 - 2002	Totals for Methods
ITV Goal = 13% of courses appropriate for TSL delivery 1,835 average students/course each year	Install 20 downlinks. Upgrade infrastructure. Explore uplink partnering agreements.	Upgrade infrastructure. Establish partnering agreements for course delivery.	Upgrade network infrastructure (see Internet block below)	Establish bridges to channel ITV broadcast to desktop	Convert some ITV for delivery via high-speed network and merge with Internet capabilities	
	Convert 3 courses	Convert 4 courses	Convert 4 courses	Convert 4 courses	Convert 4 courses	19 courses converted
	5,505 potential students	7,340 potential students	7,340 potential students	7,340 potential students	7,340 potential students	34,865 potential students
MM Goal = 73% of courses appropriate for TSL delivery 2,560 average students/course each year	Establish 100 learning centers with at least 6 multimedia workstations each. Establish Centers of Excellence.	Establish 50 learning centers with at least 6 multimedia workstations each.	Establish 50 learning centers with at least 6 multimedia workstations each. Begin upgrading individual workstations.	Merge with Internet capabilities. Deliver via CD-ROM or high-speed network.	Continue merge with Internet capabilities; Deliver via CD-ROM or high-speed network.	
	Convert 15 courses	Convert 20 courses	Convert 25 courses	Convert 25 courses	Convert 25 courses	110 courses converted
	38,400 potential students	51,200 potential students	64,000 potential students	64,000 potential students	64,000 potential students	281,600 potential students
Internet Goal = 14% of courses appropriate for TSL deliver 1,764 average students/course each year	Establish standards for WWW browser software. Adopt standards for HTML formats used for TSL. Achieve 80% connectivity across DOE.	Achieve 100% connectivity across DOE complex. Purchase site licenses for browser software, including plug-ins necessary to deliver CBT/ITV.	Purchase and install network upgrades at each site where necessary to provide high-speed digital transmission.	Begin delivery of CBT via Internet on the high-speed network.	Begin delivery of ITV/video via Internet on the high-speed network.	
		Convert 4 courses	Convert 5 courses	Convert 5 courses	Convert 7 courses	21 courses converted
		7,056 potential students	8,820 potential students	8,820 potential students	12,348 potential students	37,044 potential students
Totals for Each Year	18 courses converted	28 courses converted	34 courses converted	34 courses converted	36 courses converted	150 courses converted

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Appendix G

Analysis of Benefits and Costs Spreadsheet Elements

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Appendix G. Analysis of Benefits and Costs Spreadsheet Elements

G.1 Assumptions

Table G-1 summarizes the assumptions that were made during the analysis of benefits and costs.

Table G-1. Assumptions Used in Analysis

ASSUMPTIONS		
Technology Acquisition Costs		
Satellite Uplink	(\$ / uplink)	\$ 750,000
Satellite Downlink (w/ 20 "one-touch")	(\$ / downlink)	\$ 20,000
Classroom Conversion to ITV Capability	(\$ / conv.)	\$ 15,000
Production Studio	(\$ / studio)	\$1,000,000
CBT capable machine	(\$ / computer)	\$ 3,500
Multi-media training center (without com)	(\$ / center)	\$ 5,000
Server Acquisition and Installation	(\$ / server)	\$ 15,000
Usage Fees		
Satellite Air time	(\$ / hour)	\$ 134
Line rate (for "one-touch" system)	(\$ / hour / site)	\$ 4.80
Satellite uplink service charge	(\$ / year / site)	\$ 37,068
Satellite downlink service charge	(\$ / year / site)	\$ 768
Fixed Studio Operations Costs	(\$ / year)	\$ 200,000
Studio Operators Required	(FTEs / studio)	5
Computer Maintenance Fees	(\$ / year)	\$ 350
Course Conversion Costs		
ITV course conversion	Pre-Conv. Crs Hour	\$ 4,000
ITV course update	Post-Conv. Crs Hour	\$ 800
MM / CBT course conversion	Pre-Conv. Crs Hour	\$ 15,000
MM / CBT course update	Post-Conv. Crs Hour	\$ 3,000
MM / CBT course distribution	(\$ / course)	\$ 2,000
Internet course conversion	Pre-Conv. Crs Hour	\$ 5,000
Internet course update	Post-Conv. Crs Hour	\$ 1,000
Travel Assumptions		
Cost for Airline Ticket	(\$ / trip)	\$ 700
Cost of per diem (hotel/meals/etc.)	(\$ / day)	\$ 200
Average Travel Days encountered	(days)	2
Other Assumptions		
Average Federal Salary	(\$ / hour)	\$ 35
Average Contractor Salary	(\$ / hour)	\$ 35
Weighted Average Employee Salary	(\$ / hour)	\$ 35
Weighted Average Annual Salary	(\$ / FTE)	\$ 70,000
Hours Lost for Travel	(hours / trip)	4
Course Delivery Method if not Distance Learning		
Deliver Course on Site with site instructors		84%
Deliver Course on site with traveling Instructor		1%
Send students to other sites		2%
Not Provide Course		13%

Where possible, the assumptions shown in table G-1 were based on DOE's existing experience. The following sections provide a description of each assumption and identify the specific inputs to the model.

G.1.1 Technology Acquisition Costs

The following technology acquisition cost estimates were used in this analysis.

Satellite Uplink Costs: The cost to buy and install satellite uplink dishes and necessary hardware. This analysis assumes the cost to be \$750,000 based on Central Training Academy (CTA) and industry experience.

Satellite Downlink Costs: The cost to buy and install satellite downlink dishes and necessary hardware. This analysis assumes the cost to be \$20,000 per downlink based on the DOE Video Teleconferencing Services report dated July 1996.

Classroom Conversion to ITV Capability Costs: The cost to convert an existing classroom to an ITV capable classroom, which includes the cost of television monitors, desks, "one-touch" student response keypads, and other associated hardware. This cost does not include the cost of building expansion or major building modifications. This analysis assumes the cost to be \$15,000 per classroom.

Production Studio Costs: The cost to equip a production studio for ITV course delivery. This analysis assumes the cost to be \$1,000,000 based on CTA's experience.

MM/CBT Capable Computers: The cost for obtaining computer hardware and software capable of delivering MM/CBT courses. This analysis assumes the cost to be \$3,500 per computer.

Multimedia Learning Center Conversion Costs: The cost of converting an existing classroom to an MM/CBT computer learning center. This analysis assumes the cost to be about \$5,000 per classroom, which does not include the cost of computers.

Server Acquisition and Installation: The cost of acquiring and installing a network server.

G.1.2 Usage Fees

The following usage fees were estimated for this analysis.

Satellite Air Time: The cost of renting satellite air time to broadcast ITV courses. This analysis assumes the cost to be approximately \$134 per hour based on current DOE experience as identified in the DOE Video Teleconferencing Services report dated July 1996.

Terrestrial Line Rate: The "one-touch" student voice and data response system is used in the CTA format to monitor student feedback when delivering courses via ITV. This system transmits

student input back to the host studio via traditional terrestrial phone lines. Each site must be connected at an assumed rate of \$4.80 per hour based on current DOE experience.

Satellite Uplink/Downlink Service Charge: DOE pays a monthly service charge for maintenance of its satellite uplink and downlink equipment. This analysis assumes the monthly service charges to be \$3,089 per month for uplinks and \$64 per month for downlinks based on current DOE experience.

Fixed Studio Operations Costs: The cost of maintaining and operating an ITV production studio. This analysis assumes a cost of \$200,000 per year.

Studio Operators: The number of full-time studio operators required to operate a satellite uplink facility. This analysis assumes five operators.

Computer Maintenance Fees: The cost of maintaining and upgrading computer hardware and software and is assumed to be 10 percent of the initial purchase price. This analysis assumes \$350 per year.

G.1.3 Course Conversion Costs

The following course conversion costs were estimated for this analysis.

ITV Course Conversion Costs: The cost incurred to convert an existing course into an ITV deliverable format. The cost of ITV course conversion ranges from \$4,000 to \$20,000 per hour depending on the complexity of the topic and the quality of the final product. This analysis assumes that a mix of high and low cost training is developed. The actual cost will depend on the percentage of courses converted at each level of complexity.

ITV Course Update: This reflects the cost of updating existing ITV courses to incorporate new material. The cost of updating ITV courses is assumed to be \$800 per course hour.

MM/CBT Course Conversion: The cost incurred to convert an existing course to MM/CBT. The cost varies from \$4,000 to \$15,000 per hour depending on the complexity and quality of the final product. This analysis assumes that course conversion will cost \$15,000 per hour when developed internally.

MM/CBT Course Update: The cost of updating existing courses to reflect new learning objectives and incorporate changes. This analysis assumes a cost of \$3,000 per course hour for updates.

MM/CBT Course Distribution: The cost of duplicating and distributing courses to all DOE organizations. This analysis assumes that 200 copies of each title would be produced at a cost of \$10 per copy for a total cost of \$2,000 per title.

Internet Course Conversion: The cost of converting an existing course into one usable through the Internet. Due to current limitations in the Internet infrastructure, courses must be limited in complexity and are therefore less expensive than traditional MM/CBT courses. For this analysis, the cost of course conversion to an Internet format is assumed to be \$5,000 per course hour.

Internet Course Update: The cost of updating an existing course to reflect changes in learning objectives. This analysis assumes the course update cost to be \$1,000 per hour.

G.1.4 Travel Assumptions

The following costs associated with travel were estimated for this analysis.

Cost of Airline Tickets: This analysis assumes the cost of an average air trip to be \$700.

Cost of Travel Per Diem: This cost covers ground transportation, hotel accommodations, meals, and other sundry expenses associated with travel. For this analysis, \$200 per day was assumed.

Average Travel Days Encountered: The number of travel days associated with attending training at another DOE or non-DOE site. This analysis assumes that 2 days of travel are involved.

G.1.5 Other Assumptions

The following salary and other assumptions were made for this analysis.

Average Federal Salary: The average salary used for cost and benefit calculations was assumed to be \$35 per hour for DOE Federal employees.

Average Contractor Salary: The average salary used for cost and benefit calculations was assumed to be \$35 per hour for DOE contractor employees.

Weighted Average Employee Salary: The weighted average employee salary is based on \$35 per hour.

Weighted Average Annual Salary: The weighted average annual salary is based on a 2,000-hour year and on the average Federal and contractor salary. When calculating the weighted average, it was assumed that there were seven times as many contractor employees as Federal employees.

Hours Lost for Travel: The number of hours per trip that are spent doing non-value added activities such as making travel arrangements, traveling to and from airports, and in-air time. This analysis assumes 4 unproductive hours for each trip.

Partnership Benefits: It was assumed participation in internal and external partnerships will reduce advanced training technology development and delivery costs in the range of 15 to 40 percent during the 5-year approach defined by this business case.

G.1.6 Course Delivery Method if Not Technology-Supported Learning

Courses that are delivered through non-technology-supported learning media were assumed to be performed using one of the following methods.

- Deliver course on student's site using site instructors - 84 percent
- Deliver course onsite, but use an instructor from the organization - 1 percent
- Send student to another site to receive training - 2 percent
- Not provide the training - 13 percent

In addition to the above assumptions, a series of benefits and costs were identified and quantified based on input from the Alternative Characterization worksheet described in section G.2.

G.2 Alternative Characterization

Each alternative utilizes a different mix of training media, which in turn drives the equipment, course conversion, and course delivery needs. To evaluate each alternative, a series of inputs to the analysis of benefits and costs model were used to reflect the unique characteristics of the alternative being considered. The following inputs were used.

Courses Converted: The number of courses that will be converted to each medium being considered (ITV, MM/CBT, Internet). Each course is assumed to be of average length as identified in section G.3.

Satellite Uplinks: The number of satellite uplinks to be acquired.

Satellite Downlinks: The number of satellite downlinks to be acquired.

Classroom Conversion to ITV: The number of classrooms to be converted to an ITV-capable format.

Classroom Conversion to MM/CBT Learning Center: The number of classrooms converted to an MM/CBT-capable learning center.

ITV Production Studios: The number of ITV production studios (generally the same as the number of satellite uplinks).

Partnerships for MM/CBT Course Development: The source of MM/CBT courses. This breakdown impacts the true cost of courses for the Department.

ITV Quality: The general quality of the final product. Some courses will be of the highest quality (and corresponding cost) while others will be of a more cost effective quality. The breakdown between the two extremes impacts the average cost for ITV course conversion.

Percentage of Courses Updated: The percentage of courses that will be updated annually to reflect changes in learning objectives.

Average Student Enrollment: The average number of students enrolled in the “average” course for each delivery method.

Corporate/Non-corporate Approach Multipliers: These multipliers are used to factor in the effect of not using a corporate approach to expand technology-supported learning.

Enrollment (due to Advertisement) - This factor is used to modify the “average” number of students per course when a corporate approach to training is not used. A non-corporate approach will limit the effectiveness of technology-supported learning because not all students will be using the same course catalog resulting in lower average course enrollment.

MM/CBT Conversion Learning Curve - This factor is used to modify the cost of course development to include the effect of a non-coordinated approach to development. Since lessons learned will not be formally shared, many individuals and organizations within the Department will need to re-learn lessons already experienced by others.

Elimination of Redundant MM/CBT Course Development - Another cost of not using a corporate approach is the redundant course development that will likely occur. This multiplier is used to increase the overall course development cost to reflect this inefficiency.

MM/CBT Incompatibility - This factor is used to modify the average course enrollment to reflect the impact of not using a standard MM/CBT training platform.

G.3 Usage Estimates

The third worksheet in the analysis of benefits and costs model was the Usage Estimates worksheet, which includes information pertaining to class size, length, compression ratios, etc.

Number of Organizations Using Each Medium: The number of organizations (e.g., Headquarters, field sites, laboratories) that are assumed to use each medium.

Number of Courses Offered: The number of courses offered in each medium and is based on the “alternative characterization” inputs from above.

Average Course Length: The average course length assumed for each medium.

Course Compression Time: The percentage of post-converted course length to the pre-converted course length. For example, a course that was 10 hours long when taught in a traditional classroom and is 6 hours long when using technology-supported learning has been compressed to 60 percent of its original length.

Pre-converted Course Length: The length of the average course prior to converting to a technology-supported delivery method and is obtained by dividing the post-converted course length by the compression factor.

Average Number of Students: The average number of students assumed to attend each course.

Total Number of Students: The total number of students that take a course using the particular delivery method. It is calculated by multiplying the “average number of students” by the “courses offered.”

Total Hours of Instruction: The total hours of instruction is obtained by multiplying the “total number of students” by the “average course length.”

Students Who Avoid Travel: The number of students who avoid travel by using a technology-supported learning delivery method and is based on the “total number of students” and the percentage that would travel to another location if technology-supported learning was not available.

G.4 Description of Benefits and Costs

The benefits and costs of each alternative were explicitly identified in the detailed benefits and costs worksheets and were divided into the following categories:

- Non-Recurring Benefits (none identified in this analysis)
- Recurring Benefits
- Non-Recurring Costs
- Recurring Costs

Total Capital Invested: The total capital investment needed over the 5-year period. This number is expressed in "real" (fiscal year 1997) dollars and should be adjusted upward slightly to account for inflation when developing capital budgets (as shown in chapter 7).

The following paragraphs provide examples of each type of benefit and cost and identify the specific ones used for this analysis.

G.4.1 Quantifiable Recurring Benefits

Recurring benefits are benefits that will be realized on a continuing basis once the technology-supported learning initiative is underway. The following quantifiable recurring benefits were included in the analysis of benefits and costs.

Air Travel Reduction

Currently, many employees must travel to other DOE or non-DOE facilities to receive or provide training, which often involves air travel and significant per diem expenses (lodging, ground transportation, meals, etc.). An important goal of technology-supported learning is to reduce the amount of training-related travel. Although it was assumed that a relatively low percentage of the total number of students instructed in any particular topic would have to travel, the savings from travel reductions was still significant. This cost was quantified by multiplying the number of students expected to travel by the sum of an average airline ticket and the cost of 2 days per diem.

Avoidance of Lost Time

Another cost associated with travel is the non-productive time spent: 1) arranging travel and lodging accommodations, 2) traveling to and from airports, 3) checking bags and ticketing, and 4) flight time (although this time might be productive in many cases). For this analysis, it was assumed that 4 hours of non-value added time were consumed for each trip. The 4 hours of non-value-added time were multiplied by an average employee salary and the number of students traveling to arrive at the total cost for the Department.

Reduction in Instructor Costs

Expanded use of technology-supported learning can significantly reduce (or eliminate) the need for instructors within the Department. If courses are generally taught using onsite instructors, the use of ITV can reduce the total number of instructors to one or two. Multimedia learning activities eliminate the need for instructors.

Course Compression

Technology-supported learning media have proven to be highly effective techniques for education and training and often result in a reduction in course delivery time when compared to traditional classroom lecture approaches. This reduction in course length results in a significant reduction in student “in-class” time.

G.4.2 Quantifiable Non-Recurring Costs

Non-recurring costs are associated with an investment alternative that does not repeat year after year. Typical non-recurring costs include initial equipment purchases, equipment installation, training, and other one-time costs. The following non-recurring costs were quantified and included in this analysis.

ITV Production Studios

The model being considered for expanded use of technology-supported learning via ITV relies on broadcasting courses over digital satellite and using the “one-touch” system of keypads to monitor students’ progress and feedback. This training requires a production studio including cameras, backdrops, and control consoles. DOE currently has one production studio at the Central Training Academy and is building another at Savannah River Operations. Additional production studios might be required depending on the specific alternative being considered.

Satellite Uplink/Downlinks

Satellite uplinks and downlinks are required to send and receive ITV learning activities. The Department already has one digital satellite uplink facility at CTA and several downlink facilities. The alternatives being considered call for installing additional satellite uplink facilities (when additional production studios are required) and additional downlink facilities to expand the number of sites that have access to training courses.

Classroom Conversion (to ITV Compatible)

In addition to a satellite downlinks, DOE organizations must convert at least one classroom to an ITV-capable classroom if they are to receive satellite broadcasts. The conversion costs cover the installation of television monitors, desks, “one-touch” keypads, and other related electronics. For this analysis, it was assumed that existing classrooms would be converted rather than building dedicated classroom facilities.

Course Conversion (to ITV/Multimedia/Internet Format)

An important non-recurring cost is the initial conversion of classroom courses to a technology-supported learning format. The cost of course conversion varies widely based on the delivery method being used, the topic complexity, and the quality of the final product. The numbers in this analysis are based on the Department’s experience and benchmarking data from other sources. Table G-2 shows a range of course development costs for the primary delivery methods and the conversion cost per hour of pre-converted course length. See appendix J for source information.

Table G-2. Range of Course Development Costs

Delivery Method	Course Conversion (dollars per hour)
ITV	\$2,000-\$14,000
MM/CBT	\$5,000-\$25,000
Internet	\$2,000-\$10,000

Installing Multimedia Learning Centers With Computers

Delivering learning activities using MM/CBT requires the use of a multimedia-capable computer. Although the Department is purchasing multimedia computers, they are not widely available for training. To effectively use MM/CBT as an education and training delivery method, additional learning centers dedicated to MM/CBT training will be required. Each learning center will need between 2 and 25 multimedia computers depending on the number of employees served. For this analysis, it was assumed that each learning center would be equipped with six multimedia computers. The cost for classroom conversion assumes that an existing classroom is available and can be converted rather than building a dedicated facility.

Internet Server Acquisition and Installation

A computer server will be required for maintaining the Internet training program. This cost category is used to identify the cost of additional servers that might be needed by the Department if existing capacity is not adequate.

G.4.3 Quantifiable Recurring Costs

Recurring costs are expected to be incurred on a continuing basis. Examples of recurring costs are equipment operating expenses, ongoing technical support, license agreements, and usage fees. The following costs were explicitly identified in this analysis.

ITV Studio Operation

An ongoing cost of technology-supported learning is the operation of the ITV production studio. The operating costs cover fixed expenses associated with studio and equipment operation and maintenance.

Instructor Preparation

Considerable effort to develop course material, graphics, and other props is required by the instructor prior to delivering an ITV course. This cost category is used to identify these costs.

Satellite Air Time

Satellite air time must be rented for the actual learning activity delivery. The cost of satellite air time was assumed to be \$134/hour and is based on DOE's current experience at CTA.

Site Facilitators for Select ITV Learning Activities

Some learning activities require both classroom lecture type modules as well as hands-on practice. Since the ITV instructor is physically separated from the students, onsite facilitators are required to assist students during the hands-on segments. For this analysis, it was assumed that onsite facilitators would be required for 50 percent of the learning activities delivered through ITV.

Monthly Service Charges for Uplink/Downlink Equipment

Uplink and downlink service charges are paid to ensure equipment reliability. DOE currently pays \$3,089 for each uplink facility and \$64 for each downlink facility per month.

Terrestrial Line Usage

Standard terrestrial lines are used to transmit the "one-touch" keypad signals and students' voice responses back to the host production studio. A terrestrial line usage fee of \$4.80 per hour must be paid for each organization participating in an ITV course.

Course Updates

Updates to course materials will be required when the learning objectives for a training course are updated. To accommodate this change, this analysis assumes that 20

percent of all titles will be updated annually at a cost of 20 percent of the original course conversion cost.

Centralized Help/Hotline for Multimedia Support

To ensure the ease of use of multimedia and computer-based training learning activities, a centralized help hotline will be established to assist students and proctors when setting up and operating equipment and to ensure learning activities are properly loaded and used. The hotline will be operated from one central location.

Site Proctors and System Administrators for Multimedia Learning Centers

Organizations that currently use multimedia learning activities have found that a proctor or system administrator is required to help students load and use MM/CBT learning activities. The proctor also ensures test security is maintained for courses that require completion exams. Although the level of effort required by the site proctor/system administrator varies widely, this analysis assumes that 0.2 full-time equivalents (FTEs) will be required for each learning center.

Course Distribution

In addition to learning activity development, duplication and distribution costs will be incurred for multimedia/CBT learning activities. Learning activity distribution will also be incurred as existing courses are updated to reflect changes in module objectives. This analysis assumes that 200 copies will be produced and distributed for each learning activity at a cost of \$10 per copy.

Computer Hardware/Software Maintenance

Ongoing computer software will be required for MM/CBT computers. This cost category is used to identify (and quantify) this support.

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Appendix H

Analysis of Benefits and Costs for Alternatives A, B, and C

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Appendix H

Analysis of Benefits and Costs for Alternatives A, B, and C

Sections H.1 through H.3 provide summaries of the analysis of benefits and costs performed for alternatives A, B, and C. The summaries include the net present value, return on investment, and benefit/cost ratio for each alternative.

Note: Some language inconsistencies occur in the worksheets provided in this appendix. These inconsistencies do not affect the results of the analysis or the business case recommendations.

H.1 Focus on Interactive Television (Alternative A)

Alternative A is characterized by its use of interactive television (ITV) as the primary means of technology-supported learning delivery. This alternative calls for installing digital satellite downlink facilities at 5 sites in fiscal year 1997 and at 25 sites in fiscal year 1998.

Alternative A calls for establishing a total of 100 MM/CBT learning centers with at least 6 multimedia workstations in each center. The learning centers would be distributed throughout the DOE complex.

It is assumed that local networks will be upgraded to enable 100 percent connectivity to the Internet by fiscal year 2000 and that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancements.

A total of 150 courses would be converted to a technology-supported learning delivery method with 75 to ITV, 45 to MM/CBT, and 30 to an Internet format.

A summary of the recurring and non-recurring benefits and costs and the net present value, return on investment, and benefit/cost ratio are provided in table H-1. Figure H-1 graphically depicts the individual and cumulative cash flows for this alternative. Table H-2 provides the alternative A characterization, table H-3 provides alternative A usage estimates, and table H-4 provides a summary of the analysis data for alternative A.

Table H-1. Summary of Alternative A Benefits and Costs

ANALYSIS OF BENEFITS AND COSTS							
Non-recurring Benefits		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits		\$ -	\$ 3,184,562	\$ 11,030,703	\$ 20,670,219	\$ 30,930,865	\$ 41,192,301
Non-recurring Costs		\$ -	\$ (4,025,692)	\$ (2,754,492)	\$ (3,076,323)	\$ (2,703,062)	\$ (4,143,523)
Recurring Costs		\$ -	\$ (1,301,904)	\$ (2,753,301)	\$ (4,066,659)	\$ (5,077,667)	\$ (6,502,491)
	Net Result	\$ -	\$ (2,143,034)	\$ 5,522,910	\$ 13,527,237	\$ 23,150,136	\$ 30,546,287
OMB Discount Rate		3.1%					
Net Present Value		\$ 60,302,037					
Return on Investment		360%					
Benefit/ Cost Ratio		2.89					

Figure H-1. Alternative A Cash Flows

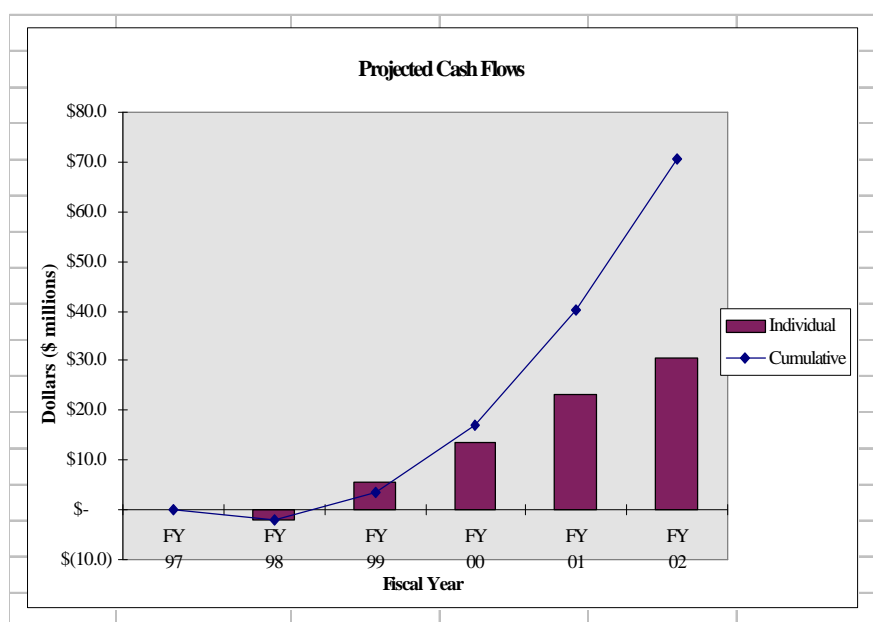


Table H-2. Alternative A Characterization
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	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02
Alternative Characterization						
<i>Courses Converted</i>						
ITV		15	15	15	15	15
Multi-Media / CBT		7	7	10	10	11
Internet		0	6	8	8	8
Total Courses Converted		0	22	28	33	34
<i>Cumulative Courses Converted</i>						
ITV	0	15	30	45	60	75
Multi-Media / CBT	0	7	14	24	34	45
Internet	0	0	6	14	22	30
Total Courses Converted	0	22	50	83	116	150
<i>Technology Acquisition</i>						
Satellite Uplink Facilities	1	0	0	0	0	1
Satellite Downlink Facilities	5	25	0	0	0	0
Classroom Conversion to ITV		25	0	0	0	0
Classroom conversion to training center		50	25	25	0	0
Number of Computers per training center		6	6	6	6	6
ITV Production Studios		0	0	0	0	1
MM / CBT computers (in training centers)		300	150	150	0	0
MM / CBT computers (stand alone Internet)		0	0	0	0	0
Servers needed to support Internet		0	0	0	0	0
<i>Technology Acquisition (Cumulative)</i>						
Satellite Uplink Facilities		0	0	0	0	1
Satellite Downlink Facilities		25	25	25	25	25
Classroom Conversion to ITV		25	25	25	25	25
Training Centers		50	75	100	100	100
Production Studios		0	0	0	0	1
Multi-media computer platforms		0	0	0	0	0
<i>Partnerships for ITV Course Development (approximate percent of total)</i>						
Partnering (2 way - 50%)	10%	10%	10%	10%	10%	10%
Partnering (5 way - 20%)	10%	10%	10%	10%	10%	10%
DOE Developed (100%)	80%	80%	80%	80%	80%	80%
Discount Multiplier	87%	87%	87%	87%	87%	87%
<i>Partnerships for MM Course Development (approximate percent of total)</i>						
Obtained Free [0% of full cost] (% of total converted)	20%	20%	20%	20%	20%	20%
Partnering [33% of full cost] (% of total converted)	10%	10%	10%	10%	10%	10%
Purchased [67% of full cost] (% of total converted)	20%	20%	20%	20%	20%	20%
Internally Developed [full cost] (% of total converted)	50%	50%	50%	50%	50%	50%
<i>Partnerships for MM Course Development (by course)</i>						
Obtained Free [0% of full cost]	(Courses) -	1.0	1.0	2.0	2.0	2.0
Partnering [33% of full cost]	(Courses) -	1.0	1.0	1.0	1.0	1.0
Purchased [67% of full cost]	(Courses) -	1.0	1.0	2.0	2.0	2.0
Internally Developed [full cost]	(Courses) -	4.0	4.0	5.0	5.0	6.0
<i>Partnerships for Internet Course Development (approximate percent of total)</i>						
Free (0%)	5%	5%	5%	5%	10%	10%
Partnering (3 way - 33%)	5%	5%	5%	5%	10%	10%
DOE Developed (100%)	90%	90%	90%	90%	80%	80%
Discount Multiplier	92%	92%	92%	92%	83%	83%
<i>ITV Quality (% of courses of each type)</i>						
CTA Level (\$20,000 / hour)	50%	50%	50%	50%	50%	50%
Junior College Type (\$4,000 / hour)	50%	50%	50%	50%	50%	50%
<i>Percent of Courses Updated (yearly)</i>						
ITV	20%	20%	20%	20%	20%	20%
MM / CBT	20%	20%	20%	20%	20%	20%
Internet	20%	20%	20%	20%	20%	20%
<i>Average Class Enrollment Assumptions</i>						
ITV	1,835	1,835	1,835	1,835	1,835	1,835
MM / CBT	2,561	2,561	2,561	2,561	2,561	2,561
Internet	1,765	1,765	1,765	1,765	1,765	1,765
<i>Corporate/ Non-corporate approach Multipliers</i>						
Enrollment (due to advertisement)	100%	100%	100%	100%	100%	100%
Conversion Cost						
MM / CBT Conversion Learning Curve	100%	100%	100%	100%	100%	100%
Elimination of Redundant MM / CBT Course Devlp.	100%	100%	100%	100%	100%	100%
MM / CBT Conversion Cost Multiplier	100%	100%	100%	100%	100%	100%
MM / CBT Incompatibility	100%	100%	100%	100%	100%	100%

Table H-3. Alternative A Usage Estimates

		FY	FY	FY	FY	FY	FY
USAGE ESTIMATES		97	98	99	00	01	02
<i>ITV Training</i>							
Number of Organizations using ITV			20	45	45	45	45
Number of courses offered using ITV			7	22	37	52	67
Average Length of Course (post converted hours)		6	6	6	6	6	6
Number of Students per course using ITV		1835	1835	1835	1835	1835	1835
Course Compression time (% of lecture time)			65%	65%	65%	65%	65%
Pre-Converted Course Length	(hours)		9.23	9.23	9.23	9.23	9.23
Classroom Instructor Prep Time	hours / course hour		4	4	4	4	4
ITV Prep Ratio (hr Prep per hr. class)			5	5	5	5	5
Percent of Classes needing a Facilitator			50%	50%	50%	50%	50%
Facilitator Time required per class(hours / class)			16	16	16	16	16
Total Number of Courses delivered			7	22	37	52	67
Total Number of Classes (# courses times # sites)			140	990	1,665	2,340	3,015
Total Number of Students			12,845	40,370	67,895	95,420	122,945
Total Hours of Instruction			77,070	242,220	407,370	572,520	737,670
Students who avoid travel with ITV			257	807	1,358	1,908	2,459
<i>Multi-Media / Computer Based Training</i>							
Number of organizations using multi-media courses			50	50	50	50	50
Number of courses offered using MM / CBT		0	3	10	19	29	39
Average Length of Course (hours)		6	6	6	6	6	6
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length		9.2	9.2	9.2	9.2	9.2	9.2
Percent of Courses "Refreshed" each year		20%	20%	20%	20%	20%	20%
Centralized Help Line Support (FTEs per year)			1	1	1	1	1
Proctors / Training Center (FTEs / center)			0.20	0.20	0.20	0.20	0.20
Average Number of Students per course		2,560	2,560	2,560	2,560	2,560	2,560
Total Number of Students Instructed		-	7,680	25,600	48,640	74,240	99,840
Students who avoid travel with MMCBT			154	512	973	1,485	1,997
<i>Internet Training</i>							
Number of organizations using Internet			50	50	50	50	50
Number of courses offered using Internet		0	0	3	10	18	26
Average Length of Course (hours)		6	6	6	6	6	6
Number of Times Course is Delivered		3	3	3	3	3	3
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length	(hours)	9.2	9.2	9.2	9.2	9.2	9.2
Average Number of Students per course		1,764	1,764	1,764	1,764	1,764	1,764
Total Number of Students		-	-	5,292	17,640	31,752	45,864
Total Hours of Instruction			-	31,752	105,840	190,512	275,184
Students who avoid travel with Internet training			-	106	353	635	917

Table H-4. Summary of Alternative A Analysis Data

		FY	FY	FY	FY	FY	FY
SUMMARY		97	98	99	00	01	02
Non-recurring Benefits							
No "Non-recurring Benefits" identified							
Total Non-recurring Benefit		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits							
ITV							
Air Travel Reduction	(\$ / year)	\$ -	\$ 565,180	\$ 1,776,280	\$ 2,987,380	\$ 4,198,480	\$ 5,409,580
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 71,932	\$ 226,072	\$ 380,212	\$ 534,352	\$ 688,492
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ -	\$ 44,100	\$ 138,600	\$ 233,100	\$ 327,600
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 2,212	\$ 15,642	\$ 26,307	\$ 36,972	\$ 47,637
Course Compression	(\$ / year)	\$ -	\$ 1,452,473	\$ 4,564,915	\$ 7,677,358	\$ 10,789,800	\$ 13,902,242
	Sub-total	\$ -	\$ 2,091,797	\$ 6,627,009	\$ 11,209,857	\$ 15,792,704	\$ 20,375,551
MULTI-MEDIA / CBT							
Air Travel Reduction	(\$ / year)	\$ -	\$ 168,960	\$ 563,200	\$ 1,070,080	\$ 1,633,280	\$ 2,196,480
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 21,504	\$ 71,680	\$ 136,192	\$ 207,872	\$ 279,552
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ 31,500	\$ 105,000	\$ 199,500	\$ 304,500	\$ 409,500
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 2,370	\$ 7,900	\$ 15,010	\$ 22,910	\$ 30,810
Course Compression	(\$ / year)	\$ -	\$ 868,431	\$ 2,894,769	\$ 5,500,062	\$ 8,394,831	\$ 11,289,600
	Sub-total	\$ -	\$ 1,092,765	\$ 3,642,549	\$ 6,920,844	\$ 10,563,393	\$ 14,205,942
INTERNET							
Air Travel Reduction	(\$ / year)	\$ -	\$ -	\$ 116,424	\$ 388,080	\$ 698,544	\$ 1,009,008
Avoidance of Lost Time	(\$ / year)	\$ -	\$ -	\$ 14,818	\$ 49,392	\$ 88,906	\$ 128,419
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ -	\$ 31,500	\$ 105,000	\$ 189,000	\$ 273,000
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ -	\$ -	\$ 2,370	\$ 7,900	\$ 14,220
Course Compression	(\$ / year)	\$ -	\$ -	\$ 598,403	\$ 1,994,677	\$ 3,590,418	\$ 5,186,160
	Sub-total	\$ -	\$ -	\$ 761,145	\$ 2,539,519	\$ 4,574,768	\$ 6,610,807
Total Recurring Benefit		\$ -	\$ 3,184,562	\$ 11,030,703	\$ 20,670,219	\$ 30,930,865	\$ 41,192,301
Non-Recurring Costs							
ITV							
Studios	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 1,000,000
Satellite Uplinks	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 300,000
Satellite Downlinks	(\$ / year)	\$ -	\$ 500,000	\$ -	\$ -	\$ -	\$ -
Classroom Conversion	(\$ / year)	\$ -	\$ 375,000	\$ -	\$ -	\$ -	\$ -
Course Conversion (ITV)	(\$ / year)	\$ -	\$ 1,144,385	\$ 1,144,385	\$ 1,144,385	\$ 1,144,385	\$ 1,144,385
	Sub-total	\$ -	\$ 2,019,385	\$ 1,144,385	\$ 1,144,385	\$ 1,144,385	\$ 2,444,385
MULTI-MEDIA / CBT							
Cost of MM computers (stand alone)	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Training Centers (w / computers)	(\$ / year)	\$ -	\$ 1,300,000	\$ 650,000	\$ 650,000	\$ -	\$ -
Course Distribution	(\$ / year)	\$ -	\$ 14,000	\$ 14,000	\$ 20,000	\$ 20,000	\$ 22,000
Course Conversion Costs	(\$ / year)	\$ -	\$ 692,308	\$ 692,308	\$ 923,538	\$ 923,538	\$ 1,062,000
	Sub-total	\$ -	\$ 2,006,308	\$ 1,356,308	\$ 1,593,538	\$ 943,538	\$ 1,084,000

Table H-4. Summary of Alternative A Analysis Data (continued)

INTERNET							
Server Acquisition and Installation	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Course Conversion Costs	(\$ / year)	\$ -	\$ -	\$ 253,800	\$ 338,400	\$ 615,138	\$ 615,138
Training Platforms	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	Sub-total	\$ -	\$ -	\$ 253,800	\$ 338,400	\$ 615,138	\$ 615,138
Total Non-Recurring Costs		\$ -	\$ 4,025,692	\$ 2,754,492	\$ 3,076,323	\$ 2,703,062	\$ 4,143,523
Recurring Costs							
IIV							
Studio Operations Costs	(\$ / year)	\$ -	\$ 108,853	\$ 342,108	\$ 575,364	\$ 808,620	\$ 1,041,875
Instructor Preparation	(\$ / year)	\$ -	\$ 19,184	\$ 60,291	\$ 101,399	\$ 142,506	\$ 183,614
Course Update	(\$ / year)	\$ -	\$ 5,846	\$ 18,374	\$ 30,902	\$ 43,430	\$ 55,958
Satellite Air Time	(\$ / year)	\$ -	\$ 14,689	\$ 46,166	\$ 77,642	\$ 109,119	\$ 140,595
Uplink Service charge	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 444,816
Facilitator Cost	(\$ / year)	\$ -	\$ 117,600	\$ 831,600	\$ 1,398,600	\$ 1,965,600	\$ 2,532,600
Downlink service charge	(\$ / year)	\$ -	\$ 230,400	\$ 230,400	\$ 230,400	\$ 230,400	\$ 230,400
Terrestrial Line Usage	(\$ / year)	\$ -	\$ 4,032	\$ 28,512	\$ 47,952	\$ 67,392	\$ 86,832
	Sub-total	\$ -	\$ 500,604	\$ 1,557,451	\$ 2,462,259	\$ 3,367,067	\$ 4,716,691
MULTI-MEDIA / CBT							
Course Update	(\$ / year)	\$ -	\$ 10,800	\$ 36,000	\$ 68,400	\$ 104,400	\$ 140,400
Training Center computer maintenance	(\$ / year)	\$ -	\$ 17,500	\$ 26,250	\$ 35,000	\$ 35,000	\$ 35,000
Centralized Help Line Support	(\$ / year)	\$ -	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000
Site Proctors / Systems Administrators	(\$ / year)	\$ -	\$ 700,000	\$ 1,050,000	\$ 1,400,000	\$ 1,400,000	\$ 1,400,000
Course Re-distribution	(\$ / year)	\$ -	\$ 3,000	\$ 10,000	\$ 19,000	\$ 58,000	\$ 78,000
	Sub-total	\$ -	\$ 801,300	\$ 1,192,250	\$ 1,592,400	\$ 1,667,400	\$ 1,723,400
INTERNET							
Course Update	(\$ / year)	\$ -	\$ -	\$ 3,600	\$ 12,000	\$ 43,200	\$ 62,400
	Sub-total	\$ -	\$ -	\$ 3,600	\$ 12,000	\$ 43,200	\$ 62,400
Total Recurring Costs		\$ -	\$ 1,301,904	\$ 2,753,301	\$ 4,066,659	\$ 5,077,667	\$ 6,502,491

H.2 Focus on Multimedia (Alternative B)

Alternative B is characterized by heavy reliance on multimedia/computer-based training (MM/CBT) as the primary means of technology-supported learning delivery. This alternative calls for installing digital satellite downlink facilities at 5 sites in fiscal year 1997 and 20 sites in fiscal year 1998.

Alternative B calls for establishing a total of 200 MM/CBT learning centers with at least 6 multimedia workstations in each center. The learning centers would be distributed throughout the DOE complex.

It is assumed that local area networks will be upgraded to enable 100 percent connectivity to the Internet by fiscal year 2000 and that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancements.

A total of 150 courses would be converted to a technology-supported learning delivery method with 19 to ITV, 110 to MM/CBT, and 21 to an Internet format.

A summary of the recurring and non-recurring benefits and costs and the net present value, return on investment, and benefit/cost ratio are provided in table H-5. Figure H-2 graphically depicts the individual and cumulative cash flows for this alternative. Table H-6 provides the alternative B characterization, table H-7 provides alternative B usage estimates, and table H-8 provides a summary of the analysis data for alternative B.

Table H-5. Summary of Alternative B Benefits and Costs

ANALYSIS OF BENEFITS AND COSTS							
Non-recurring Benefits		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits		\$ -	\$ 2,848,613	\$ 11,115,124	\$ 21,491,006	\$ 33,088,485	\$ 44,940,074
Non-recurring Costs		\$ -	\$ (4,990,569)	\$ (3,661,446)	\$ (4,221,900)	\$ (3,094,862)	\$ (3,248,646)
Recurring Costs		\$ -	\$ (1,758,294)	\$ (2,794,968)	\$ (3,835,666)	\$ (4,259,064)	\$ (4,630,062)
	Net Result	\$ -	\$ (3,900,250)	\$ 4,658,710	\$ 13,433,440	\$ 25,734,559	\$ 37,061,366
OMB Discount Rate		3.1%					
Net Present Value		\$ 65,420,479					
Return on Investment		220%					
Benefit/ Cost Ratio		3.03					

Figure H-2. Alternative B Cash Flows

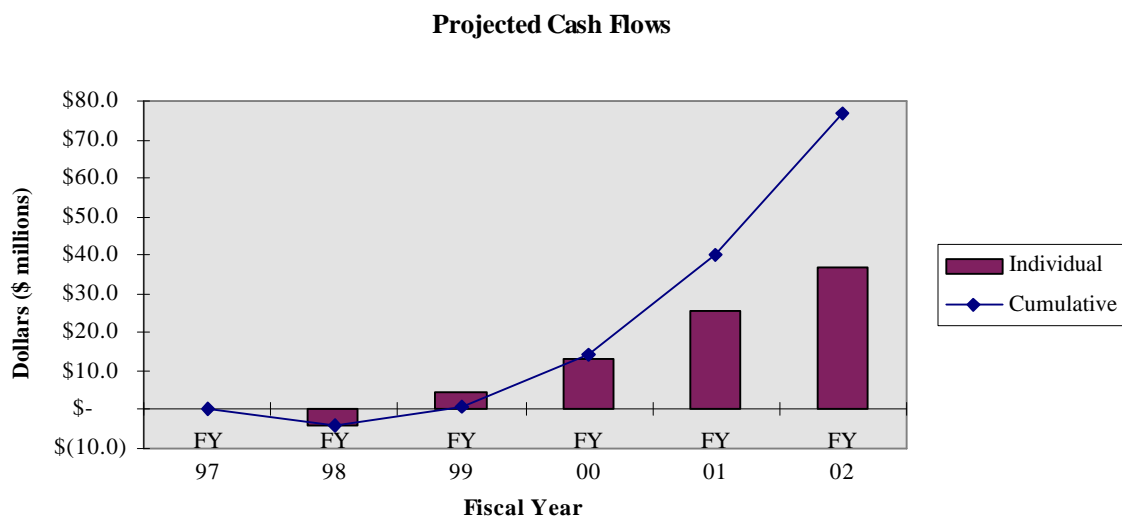


Table H-6. Alternative B Characterization
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	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02
Alternative Characterization						
Courses Converted						
ITV		3	4	4	4	4
Multi-Media / CBT		15	20	25	25	25
Internet		0	4	5	5	7
Total Courses Converted		0	18	28	34	36
Cumulative Courses Converted						
ITV		0	3	7	11	19
Multi-Media / CBT		0	15	35	60	110
Internet		0	0	4	9	21
Total Courses Converted		0	18	46	80	150
Technology Acquisition						
Satellite Uplink Facilities		1	0	0	0	0
Satellite Downlink Facilities		5	20	0	0	0
Classroom Conversion to ITV			20	0	0	0
Classroom conversion to training center			100	50	50	0
Number of Computers per training center			6	6	6	6
ITV Production Studios			0	0	0	0
MM / CBT computers (in training centers)			600	300	300	0
MM / CBT computers (stand alone Internet)			0	0	0	0
Servers needed to support Internet			0	0	0	0
Technology Acquisition (Cumulative)						
Satellite Uplink Facilities			0	0	0	0
Satellite Downlink Facilities			20	20	20	20
Classroom Conversion to ITV			20	20	20	20
Training Centers			100	150	200	200
Production Studios			0	0	0	0
Multi-media computer platforms			0	0	0	0
Partnerships for ITV Course Development (approximate percent of total)						
Partnering (2 way - 50%)		10%	10%	10%	10%	10%
Partnering (5 way - 20%)		10%	10%	10%	10%	10%
DOE Developed (100%)		80%	80%	80%	80%	80%
Discount Multiplier		87%	87%	87%	87%	87%
Partnerships for MM Course Development (approximate percent of total)						
Obtained Free [0% of full cost] (% of total converted)		20%	20%	20%	20%	20%
Partnering [33% of full cost] (% of total converted)		10%	10%	10%	10%	10%
Purchased [67% of full cost] (% of total converted)		20%	20%	20%	20%	20%
Internally Developed [full cost] (% of total converted)		50%	50%	50%	50%	50%
Partnerships for MM Course Development (by course)						
Obtained Free [0% of full cost]	(Courses)	-	3.0	4.0	5.0	5.0
Partnering [33% of full cost]	(Courses)	-	1.0	2.0	2.0	2.0
Purchased [67% of full cost]	(Courses)	-	3.0	4.0	5.0	5.0
Internally Developed [full cost]	(Courses)	-	8.0	10.0	13.0	13.0
Partnerships for Internet Course Development (approximate percent of total)						
Free (0%)		5%	5%	5%	5%	10%
Partnering (3 way - 33%)		5%	5%	5%	5%	10%
DOE Developed (100%)		90%	90%	90%	90%	80%
Discount Multiplier		92%	92%	92%	92%	83%
ITV Quality (% of courses of each type)						
CTA Level (\$20,000 / hour)		50%	50%	50%	50%	50%
Junior College Type (\$4,000 / hour)		50%	50%	50%	50%	50%
Percent of Courses Updated (yearly)						
ITV		20%	20%	20%	20%	20%
MM / CBT		20%	20%	20%	20%	20%
Internet		20%	20%	20%	20%	20%
Average Class Enrollment Assumptions						
ITV		1,835	1,835	1,835	1,835	1,835
MM / CBT		2,561	2,561	2,561	2,561	2,561
Internet		1,765	1,765	1,765	1,765	1,765
Corporate/ Non-corporate approach Multipliers						
Enrollment (due to advertisement)		100%	100%	100%	100%	100%
Conversion Cost						
MM / CBT Conversion Learning Curve		100%	100%	100%	100%	100%
Elimination of Redundant MM / CBT Course Devlp.		100%	100%	100%	100%	100%
MM / CBT Conversion Cost Multiplier		100%	100%	100%	100%	100%
MM / CBT Incompatibility		100%	100%	100%	100%	100%

Table H-7. Alternative B Usage Estimates

		FY	FY	FY	FY	FY	FY
<i>USAGE ESTIMATES</i>		97	98	99	00	01	02
<i>ITV Training</i>							
Number of Organizations using ITV			20	40	40	40	40
Number of courses offered using ITV			1	5	9	13	17
Average Length of Course (post converted hours)		6	6	6	6	6	6
Number of Students per course using ITV		1835	1835	1835	1835	1835	1835
Course Compression time (% of lecture time)			65%	65%	65%	65%	65%
Pre-Converted Course Length (hours)			9.23	9.23	9.23	9.23	9.23
Classroom Instructor Prep Time (hours / course hour)			4	4	4	4	4
ITV Prep Ratio (hr Prep per hr. class)			5	5	5	5	5
Percent of Classes needing a Facilitator			50%	50%	50%	50%	50%
Facilitator Time required per class(hours / class)			16	16	16	16	16
Total Number of Courses delivered			1	5	9	13	17
Total Number of Classes (# courses times # sites)			20	200	360	520	680
Total Number of Students			1,835	9,175	16,515	23,855	31,195
Total Hours of Instruction			11,010	55,050	99,090	143,130	187,170
Students who avoid travel with ITV			37	184	330	477	624
<i>Multi-Media / Computer Based Training</i>							
Number of organizations using multi-media courses			50	50	50	50	50
Number of courses offered using MM / CBT		0	7	25	47	72	97
Average Length of Course (hours)		6	6	6	6	6	6
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length		9.2	9.2	9.2	9.2	9.2	9.2
Percent of Courses "Refreshed" each year		20%	20%	20%	20%	20%	20%
Centralized Help Line Support (FTEs per year)			1	1	1	1	1
Proctors / Training Center (FTEs / center)			0.20	0.20	0.20	0.20	0.20
Average Number of Students per course		2,560	2,560	2,560	2,560	2,560	2,560
Total Number of Students Instructed		-	17,920	64,000	120,320	184,320	248,320
Students who avoid travel with MMCBT			358	1,280	2,406	3,686	4,966
<i>Internet Training</i>							
Number of organizations using Internet			50	50	50	50	50
Number of courses offered using Internet		0	0	2	6.5	11.5	17.5
Average Length of Course (hours)		6	6	6	6	6	6
Number of Times Course is Delivered		3	3	3	3	3	3
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length (hours)		9.2	9.2	9.2	9.2	9.2	9.2
Average Number of Students per course		1,764	1,764	1,764	1,764	1,764	1,764
Total Number of Students		-	-	3,528	11,466	20,286	30,870
Total Hours of Instruction			-	21,168	68,796	121,716	185,220
Students who avoid travel with Internet training			-	71	229	406	617

Table H-8. Summary of Alternative B Analysis Data

		FY 97	FY 98	FY 99	FY 00	FY 01	FY 02
SUMMARY							
Non-recurring Benefits							
No "Non-recurring Benefits" identified							
Total Non-recurring Benefit		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits							
ITV							
Air Travel Reduction	(\$ / year)	\$ -	\$ 80,740	\$ 403,700	\$ 726,660	\$ 1,049,620	\$ 1,372,580
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 10,276	\$ 51,380	\$ 92,484	\$ 133,588	\$ 174,692
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ -	\$ 5,600	\$ 28,000	\$ 50,400	\$ 72,800
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 316	\$ 3,160	\$ 5,688	\$ 8,216	\$ 10,744
Course Compression	(\$ / year)	\$ -	\$ 207,496	\$ 1,037,481	\$ 1,867,465	\$ 2,697,450	\$ 3,527,435
	Sub-total	\$ -	\$ 298,828	\$ 1,501,321	\$ 2,720,297	\$ 3,939,274	\$ 5,158,251
MULTI-MEDIA / CBT							
Air Travel Reduction	(\$ / year)	\$ -	\$ 394,240	\$ 1,408,000	\$ 2,647,040	\$ 4,055,040	\$ 5,463,040
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 50,176	\$ 179,200	\$ 336,896	\$ 516,096	\$ 695,296
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ 73,500	\$ 262,500	\$ 493,500	\$ 756,000	\$ 1,018,500
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 5,530	\$ 19,750	\$ 37,130	\$ 56,880	\$ 76,630
Course Compression	(\$ / year)	\$ -	\$ 2,026,338	\$ 7,236,923	\$ 13,605,415	\$ 20,842,338	\$ 28,079,262
	Sub-total	\$ -	\$ 2,549,784	\$ 9,106,373	\$ 17,119,981	\$ 26,226,354	\$ 35,332,728
INTERNET							
Air Travel Reduction	(\$ / year)	\$ -	\$ -	\$ 77,616	\$ 252,252	\$ 446,292	\$ 679,140
Avoidance of Lost Time	(\$ / year)	\$ -	\$ -	\$ 9,878	\$ 32,105	\$ 56,801	\$ 86,436
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ -	\$ 21,000	\$ 68,250	\$ 120,750	\$ 183,750
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ -	\$ -	\$ 1,580	\$ 5,135	\$ 9,085
Course Compression	(\$ / year)	\$ -	\$ -	\$ 398,935	\$ 1,296,540	\$ 2,293,878	\$ 3,490,685
	Sub-total	\$ -	\$ -	\$ 507,430	\$ 1,650,727	\$ 2,922,856	\$ 4,449,096
Total Recurring Benefit		\$ -	\$ 2,848,613	\$ 11,115,124	\$ 21,491,006	\$ 33,088,485	\$ 44,940,074
Non-Recurring Costs							
ITV							
Studios	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Uplinks	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Downlinks	(\$ / year)	\$ -	\$ 400,000	\$ -	\$ -	\$ -	\$ -
Classroom Conversion	(\$ / year)	\$ -	\$ 300,000	\$ -	\$ -	\$ -	\$ -
Course Conversion (ITV)	(\$ / year)	\$ -	\$ 228,877	\$ 305,169	\$ 305,169	\$ 305,169	\$ 305,169
	Sub-total	\$ -	\$ 928,877	\$ 305,169	\$ 305,169	\$ 305,169	\$ 305,169
MULTI-MEDIA / CBT							
Cost of MM computers (stand alone)	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Training Centers (w / computers)	(\$ / year)	\$ -	\$ 2,600,000	\$ 1,300,000	\$ 1,300,000	\$ -	\$ -
Course Distribution	(\$ / year)	\$ -	\$ 30,000	\$ 40,000	\$ 50,000	\$ 50,000	\$ 50,000
Course Conversion Costs	(\$ / year)	\$ -	\$ 1,431,692	\$ 1,847,077	\$ 2,355,231	\$ 2,355,231	\$ 2,355,231
	Sub-total	\$ -	\$ 4,061,692	\$ 3,187,077	\$ 3,705,231	\$ 2,405,231	\$ 2,405,231

Table H-8. Summary of Alternative B Analysis Data (continued)

MULTI-MEDIA / CBT							
Course Update	(\$ / year)	\$ -	\$ 25,200	\$ 90,000	\$ 169,200	\$ 259,200	\$ 349,200
Training Center computer maintenance	(\$ / year)	\$ -	\$ 35,000	\$ 52,500	\$ 70,000	\$ 70,000	\$ 70,000
Centralized Help Line Support	(\$ / year)	\$ -	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000
Site Proctors / Systems Administrators	(\$ / year)	\$ -	\$ 1,400,000	\$ 2,100,000	\$ 2,800,000	\$ 2,800,000	\$ 2,800,000
Course Re-distribution	(\$ / year)	\$ -	\$ 7,000	\$ 25,000	\$ 47,000	\$ 144,000	\$ 194,000
	Sub-total	\$ -	\$ 1,537,200	\$ 2,337,500	\$ 3,156,200	\$ 3,343,200	\$ 3,483,200
INTERNET							
Course Update	(\$ / year)	\$ -	\$ -	\$ 2,400	\$ 7,800	\$ 27,600	\$ 42,000
	Sub-total	\$ -	\$ -	\$ 2,400	\$ 7,800	\$ 27,600	\$ 42,000
Total Recurring Costs		\$ -	\$ 1,758,294	\$ 2,794,968	\$ 3,835,666	\$ 4,259,064	\$ 4,630,062
ANALYSIS OF BENEFITS AND COSTS							
Non-recurring Benefits		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits		\$ -	\$ 2,848,613	\$ 11,115,124	\$ 21,491,006	\$ 33,088,485	\$ 44,940,074
Non-recurring Costs		\$ -	\$ (4,990,569)	\$ (3,661,446)	\$ (4,221,900)	\$ (3,094,862)	\$ (3,248,646)
Recurring Costs		\$ -	\$ (1,758,294)	\$ (2,794,968)	\$ (3,835,666)	\$ (4,259,064)	\$ (4,630,062)
	Net Result	\$ -	\$ (3,900,250)	\$ 4,658,710	\$ 13,433,440	\$ 25,734,559	\$ 37,061,366
OMB Discount Rate		3.1%					
Net Present Value		\$ 65,420,479					
Return on Investment		220%					
Benefit/ Cost Ratio		3.03					

H.3 Focus on High-Speed Networks (Alternative C)

Alternative C is characterized by its use of multimedia/computer-based training (MM /CBT) to meet technology-supported learning education and training needs for fiscal year 1998 through fiscal year 2000 and increasing use of high-speed networks in fiscal years 2001, 2002, and beyond.

Alternative C calls for installing digital satellite downlink facilities at 5 sites in fiscal year 1997 and 20 sites in fiscal year 1998.

This alternative also calls for establishing a total of 200 MM/CBT learning centers with at least 6 multimedia workstations in each center. The learning centers would be distributed throughout the DOE complex.

It is assumed that local area networks will be upgraded to enable 100 percent connectivity to the Internet by fiscal year 2000, and that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancements.

A total of 150 courses would be converted to a technology-supported learning delivery method with 19 to ITV, 110 to MM/CBT, and 21 to an Internet format.

A summary of the recurring and non-recurring benefits and costs and the net present value, return on investment, and benefit/cost ratio are provided in table H-9. Figure H-3 graphically depicts the individual and cumulative cash flows for this alternative. Table H-10 provides the alternative C characterization, table H-11 provides alternative C usage estimates, and table H-12 provides a summary of the analysis data for alternative C.

Table H-9. Summary of Alternative C Benefits and Costs

ANALYSIS OF BENEFITS AND COSTS							
Non-recurring Benefits		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits		\$ -	\$ 2,848,613	\$ 11,115,124	\$ 21,491,006	\$ 33,088,485	\$ 44,940,074
Non-recurring Costs		\$ -	\$ (4,990,569)	\$ (3,661,446)	\$ (4,221,900)	\$ (3,094,862)	\$ (3,248,646)
Recurring Costs		\$ -	\$ (1,760,121)	\$ (2,804,103)	\$ (3,852,109)	\$ (4,282,815)	\$ (4,661,121)
	Net Result	\$ -	\$ (3,902,077)	\$ 4,649,575	\$ 13,416,997	\$ 25,710,808	\$ 37,030,307
OMB Discount Rate		3.1%					
Net Present Value		\$ 65,349,623					
Return on Investment		220%					
Benefit/ Cost Ratio		3.02					

Figure H-3. Alternative C Cash Flows

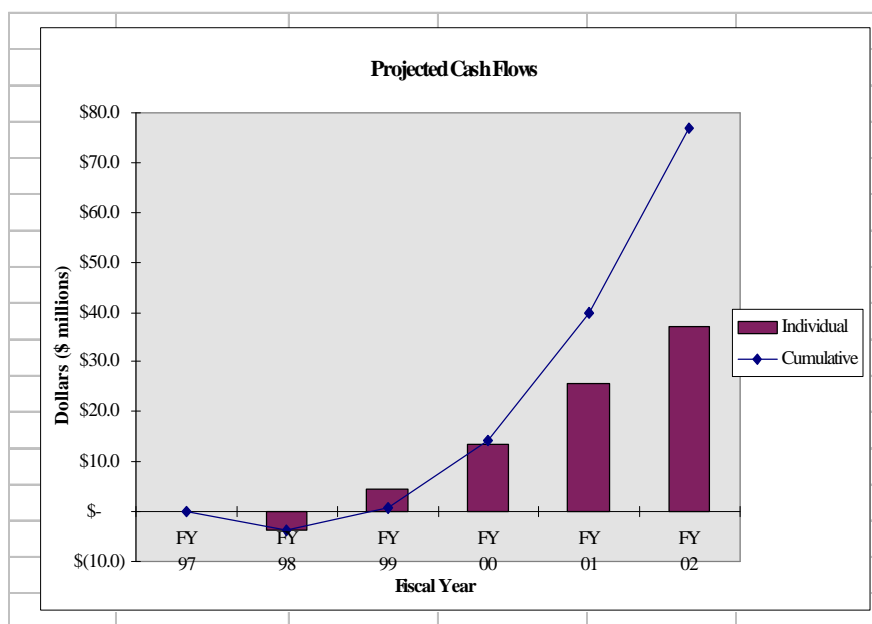


Table H-10. Alternative C Characterization
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	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02
Alternative Characterization						
<i>Courses Converted</i>						
ITV		3	4	4	4	4
Multi-Media / CBT		15	20	25	25	25
Internet		0	4	5	5	7
Total Courses Converted		0	18	28	34	36
<i>Cumulative Courses Converted</i>						
ITV		0	3	7	11	19
Multi-Media / CBT		0	15	35	60	110
Internet		0	0	4	9	21
Total Courses Converted		0	18	46	80	150
<i>Technology Acquisition</i>						
Satellite Uplink Facilities		1	0	0	0	0
Satellite Downlink Facilities		5	20	0	0	0
Classroom Conversion to ITV			20	0	0	0
Classroom conversion to training center			100	50	50	0
Number of Computers per training center			6	6	6	6
ITV Production Studios			0	0	0	0
MM / CBT computers (in training centers)			600	300	300	0
MM / CBT computers (stand alone Internet)			0	0	0	0
Servers needed to support Internet			0	0	0	0
<i>Technology Acquisition (Cumulative)</i>						
Satellite Uplink Facilities			0	0	0	0
Satellite Downlink Facilities			20	20	20	20
Classroom Conversion to ITV			20	20	20	20
Training Centers			100	150	200	200
Production Studios			0	0	0	0
Multi-media computer platforms			0	0	0	0
<i>Partnerships for ITV Course Development (approximate percent of total)</i>						
Partnering (2 way - 50%)		10%	10%	10%	10%	10%
Partnering (5 way - 20%)		10%	10%	10%	10%	10%
DOE Developed (100%)		80%	80%	80%	80%	80%
Discount Multiplier		87%	87%	87%	87%	87%
<i>Partnerships for MM Course Development (approximate percent of total)</i>						
Obtained Free [0% of full cost] (% of total converted)		20%	20%	20%	20%	20%
Partnering [33% of full cost] (% of total converted)		10%	10%	10%	10%	10%
Purchased [67% of full cost] (% of total converted)		20%	20%	20%	20%	20%
Internally Developed [full cost] (% of total converted)		50%	50%	50%	50%	50%
<i>Partnerships for MM Course Development (by course)</i>						
Obtained Free [0% of full cost]	(Courses)	-	3.0	4.0	5.0	5.0
Partnering [33% of full cost]	(Courses)	-	1.0	2.0	2.0	2.0
Purchased [67% of full cost]	(Courses)	-	3.0	4.0	5.0	5.0
Internally Developed [full cost]	(Courses)	-	8.0	10.0	13.0	13.0
<i>Partnerships for Internet Course Development (approximate percent of total)</i>						
Free (0%)		5%	5%	5%	5%	10%
Partnering (3 way - 33%)		5%	5%	5%	5%	10%
DOE Developed (100%)		90%	90%	90%	90%	80%
Discount Multiplier		92%	92%	92%	92%	83%
<i>ITV Quality (% of courses of each type)</i>						
CTA Level (\$20,000 / hour)		50%	50%	50%	50%	50%
Junior College Type (\$4,000 / hour)		50%	50%	50%	50%	50%
<i>Percent of Courses Updated (yearly)</i>						
ITV		20%	20%	20%	20%	20%
MM / CBT		20%	20%	20%	20%	20%
Internet		20%	20%	20%	20%	20%
<i>Average Class Enrollment Assumptions</i>						
ITV		1,835	1,835	1,835	1,835	1,835
MM / CBT		2,561	2,561	2,561	2,561	2,561
Internet		1,765	1,765	1,765	1,765	1,765
<i>Corporate/ Non-corporate approach Multipliers</i>						
Enrollment (due to advertisement)		100%	100%	100%	100%	100%
Conversion Cost						
MM / CBT Conversion Learning Curve		100%	100%	100%	100%	100%
Elimination of Redundant MM / CBT Course Devlp.		100%	100%	100%	100%	100%
MM / CBT Conversion Cost Multiplier		100%	100%	100%	100%	100%
MM / CBT Incompatibility		100%	100%	100%	100%	100%

Table H-11. Alternative C Usage Estimates

		FY	FY	FY	FY	FY	FY
<i>USAGE ESTIMATES</i>		97	98	99	00	01	02
<i>ITV Training</i>							
Number of Organizations using ITV			20	40	40	40	40
Number of courses offered using ITV			1	5	9	13	17
Average Length of Course (post converted hours)		6	6	6	6	6	6
Number of Students per course using ITV		1835	1835	1835	1835	1835	1835
Course Compression time (% of lecture time)			65%	65%	65%	65%	65%
Pre-Converted Course Length	(hours)		9.23	9.23	9.23	9.23	9.23
Classroom Instructor Prep Time	ours / course hour)		4	4	4	4	4
ITV Prep Ratio (hr Prep per hr. class)			5	5	5	5	5
Percent of Classes needing a Facilitator			50%	50%	50%	50%	50%
Facilitator Time required per class(hours / class)			16	16	16	16	16
Total Number of Courses delivered			1	5	9	13	17
Total Number of Classes (# courses times # sites)			20	200	360	520	680
Total Number of Students			1,835	9,175	16,515	23,855	31,195
Total Hours of Instruction			11,010	55,050	99,090	143,130	187,170
Students who avoid travel with ITV			37	184	330	477	624
<i>Multi-Media / Computer Based Training</i>							
Number of organizations using multi-media courses			50	50	50	50	50
Number of courses offered using MM / CBT		0	7	25	47	72	97
Average Length of Course (hours)		6	6	6	6	6	6
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length		9.2	9.2	9.2	9.2	9.2	9.2
Percent of Courses "Refreshed" each year		20%	20%	20%	20%	20%	20%
Centralized Help Line Support (FTEs per year)			1	1	1	1	1
Proctors / Training Center (FTEs / center)			0.20	0.20	0.20	0.20	0.20
Average Number of Students per course		2,560	2,560	2,560	2,560	2,560	2,560
Total Number of Students Instructed		-	17,920	64,000	120,320	184,320	248,320
Students who avoid travel with MMCBT			358	1,280	2,406	3,686	4,966
<i>Internet Training</i>							
Number of organizations using Internet			50	50	50	50	50
Number of courses offered using Internet		0	0	2	6.5	11.5	17.5
Average Length of Course (hours)		6	6	6	6	6	6
Number of Times Course is Delivered		3	3	3	3	3	3
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length	(hours)	9.2	9.2	9.2	9.2	9.2	9.2
Average Number of Students per course		1,764	1,764	1,764	1,764	1,764	1,764
Total Number of Students		-	-	3,528	11,466	20,286	30,870
Total Hours of Instruction			-	21,168	68,796	121,716	185,220
Students who avoid travel with Internet training			-	71	229	406	617

Table H-12. Summary of Alternative C Analysis Data

		FY	FY	FY	FY	FY	FY
SUMMARY		97	98	99	00	01	02
Non-recurring Benefits							
No "Non-recurring Benefits" identified							
Total Non-recurring Benefit		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits							
ITV							
Air Travel Reduction	(\$ / year)	\$ -	\$ 80,740	\$ 403,700	\$ 726,660	\$ 1,049,620	\$ 1,372,580
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 10,276	\$ 51,380	\$ 92,484	\$ 133,588	\$ 174,692
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ -	\$ 5,600	\$ 28,000	\$ 50,400	\$ 72,800
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 316	\$ 3,160	\$ 5,688	\$ 8,216	\$ 10,744
Course Compression	(\$ / year)	\$ -	\$ 207,496	\$ 1,037,481	\$ 1,867,465	\$ 2,697,450	\$ 3,527,435
	Sub-total	\$ -	\$ 298,828	\$ 1,501,321	\$ 2,720,297	\$ 3,939,274	\$ 5,158,251
MULTI-MEDIA / CBT							
Air Travel Reduction	(\$ / year)	\$ -	\$ 394,240	\$ 1,408,000	\$ 2,647,040	\$ 4,055,040	\$ 5,463,040
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 50,176	\$ 179,200	\$ 336,896	\$ 516,096	\$ 695,296
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ 73,500	\$ 262,500	\$ 493,500	\$ 756,000	\$ 1,018,500
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 5,530	\$ 19,750	\$ 37,130	\$ 56,880	\$ 76,630
Course Compression	(\$ / year)	\$ -	\$ 2,026,338	\$ 7,236,923	\$ 13,605,415	\$ 20,842,338	\$ 28,079,262
	Sub-total	\$ -	\$ 2,549,784	\$ 9,106,373	\$ 17,119,981	\$ 26,226,354	\$ 35,332,728
INTERNET							
Air Travel Reduction	(\$ / year)	\$ -	\$ -	\$ 77,616	\$ 252,252	\$ 446,292	\$ 679,140
Avoidance of Lost Time	(\$ / year)	\$ -	\$ -	\$ 9,878	\$ 32,105	\$ 56,801	\$ 86,436
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ -	\$ 21,000	\$ 68,250	\$ 120,750	\$ 183,750
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ -	\$ -	\$ 1,580	\$ 5,135	\$ 9,085
Course Compression	(\$ / year)	\$ -	\$ -	\$ 398,935	\$ 1,296,540	\$ 2,293,878	\$ 3,490,685
	Sub-total	\$ -	\$ -	\$ 507,430	\$ 1,650,727	\$ 2,922,856	\$ 4,449,096
Total Recurring Benefit		\$ -	\$ 2,848,613	\$ 11,115,124	\$ 21,491,006	\$ 33,088,485	\$ 44,940,074
Non-Recurring Costs							
ITV							
Studios	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Uplinks	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Downlinks	(\$ / year)	\$ -	\$ 400,000	\$ -	\$ -	\$ -	\$ -
Classroom Conversion	(\$ / year)	\$ -	\$ 300,000	\$ -	\$ -	\$ -	\$ -
Course Conversion (ITV)	(\$ / year)	\$ -	\$ 228,877	\$ 305,169	\$ 305,169	\$ 305,169	\$ 305,169
	Sub-total	\$ -	\$ 928,877	\$ 305,169	\$ 305,169	\$ 305,169	\$ 305,169
MULTI-MEDIA / CBT							
Cost of MM computers (stand alone)	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Training Centers (w / computers)	(\$ / year)	\$ -	\$ 2,600,000	\$ 1,300,000	\$ 1,300,000	\$ -	\$ -
Course Distribution	(\$ / year)	\$ -	\$ 30,000	\$ 40,000	\$ 50,000	\$ 50,000	\$ 50,000
Course Conversion Costs	(\$ / year)	\$ -	\$ 1,431,692	\$ 1,847,077	\$ 2,355,231	\$ 2,355,231	\$ 2,355,231
	Sub-total	\$ -	\$ 4,061,692	\$ 3,187,077	\$ 3,705,231	\$ 2,405,231	\$ 2,405,231

Table H-12. Summary of Alternative C Analysis Data (continued)

INTERNET							
Server Acquisition and Installation	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Course Conversion Costs	(\$ / year)	\$ -	\$ -	\$ 169,200	\$ 211,500	\$ 384,462	\$ 538,246
Training Platforms	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	Sub-total	\$ -	\$ -	\$ 169,200	\$ 211,500	\$ 384,462	\$ 538,246
Total Non-Recurring Costs							
		\$ -	\$ 4,990,569	\$ 3,661,446	\$ 4,221,900	\$ 3,094,862	\$ 3,248,646
Recurring Costs							
ITV							
Studio Operations Costs	(\$ / year)	\$ -	\$ 15,550	\$ 77,752	\$ 139,953	\$ 202,155	\$ 264,356
Instructor Preparation	(\$ / year)	\$ -	\$ 2,741	\$ 13,703	\$ 24,665	\$ 35,627	\$ 46,589
Course Update	(\$ / year)	\$ -	\$ 835	\$ 4,176	\$ 7,517	\$ 10,858	\$ 14,198
Satellite Air Time	(\$ / year)	\$ -	\$ 2,098	\$ 10,492	\$ 18,886	\$ 27,280	\$ 35,673
Uplink Service charge	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Facilitator Cost	(\$ / year)	\$ -	\$ 16,800	\$ 168,000	\$ 302,400	\$ 436,800	\$ 571,200
Downlink service charge	(\$ / year)	\$ -	\$ 184,320	\$ 184,320	\$ 184,320	\$ 184,320	\$ 184,320
Terrestrial Line Usage	(\$ / year)	\$ -	\$ 576	\$ 5,760	\$ 10,368	\$ 14,976	\$ 19,584
	Sub-total	\$ -	\$ 222,921	\$ 464,203	\$ 688,109	\$ 912,015	\$ 1,135,921
MULTI-MEDIA / CBT							
Course Update	(\$ / year)	\$ -	\$ 25,200	\$ 90,000	\$ 169,200	\$ 259,200	\$ 349,200
Training Center computer maintenance	(\$ / year)	\$ -	\$ 35,000	\$ 52,500	\$ 70,000	\$ 70,000	\$ 70,000
Centralized Help Line Support	(\$ / year)	\$ -	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000
Site Proctors / Systems Administrators	(\$ / year)	\$ -	\$ 1,400,000	\$ 2,100,000	\$ 2,800,000	\$ 2,800,000	\$ 2,800,000
Course Re-distribution	(\$ / year)	\$ -	\$ 7,000	\$ 25,000	\$ 47,000	\$ 144,000	\$ 194,000
	Sub-total	\$ -	\$ 1,537,200	\$ 2,337,500	\$ 3,156,200	\$ 3,343,200	\$ 3,483,200
INTERNET							
Course Update	(\$ / year)	\$ -	\$ -	\$ 2,400	\$ 7,800	\$ 27,600	\$ 42,000
	Sub-total	\$ -	\$ -	\$ 2,400	\$ 7,800	\$ 27,600	\$ 42,000
Total Recurring Costs							
		\$ -	\$ 1,760,121	\$ 2,804,103	\$ 3,852,109	\$ 4,282,815	\$ 4,661,121
ANALYSIS OF BENEFITS AND COSTS							
Non-recurring Benefits		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits		\$ -	\$ 2,848,613	\$ 11,115,124	\$ 21,491,006	\$ 33,088,485	\$ 44,940,074
Non-recurring Costs		\$ -	\$ (4,990,569)	\$ (3,661,446)	\$ (4,221,900)	\$ (3,094,862)	\$ (3,248,646)
Recurring Costs		\$ -	\$ (1,760,121)	\$ (2,804,103)	\$ (3,852,109)	\$ (4,282,815)	\$ (4,661,121)
Net Result		\$ -	\$ (3,902,077)	\$ 4,649,575	\$ 13,416,997	\$ 25,710,808	\$ 37,030,307
OMB Discount Rate							
		3.1%					
Net Present Value							
		\$ 65,349,623					
Return on Investment							
		220%					
Benefit/ Cost Ratio							
		3.02					

Appendix I

Abbreviations and Glossary

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Abbreviations

ABC	Analysis of benefits and costs
ADP	Automated data processing
ATT	Advanced training technologies
BCR	Benefit/cost ratio
CATV	Cable television
CBT	Computer-based training
CD-ROM	Compact disc-read only memory
CGI	Common gateway interface
CLI	Compression Labs, Inc.
CTA	Central Training Academy
CTED	Clearinghouse for Training, Education, and Development
CVTS	Compressed video teleconferencing services
DCF	Discounted cash flow
DLAST	Distance Learning Appropriateness Screening Tool
DOE	Department of Energy
DTIS	Department Training Information System
FTE	Full-time equivalent
FTS	Federal Telephone Service
GAO	General Accounting Office
Gbps	Gigabits per second
GATE	Government Alliance for Training and Education
GET	General education and training
GHz	Gigahertz
HTML	Hypertext markup language
Hz	Hertz (cycles per second)
IBM	International Business Machines
IDP	Individual Development Plan
IM	Information Management
ISDN	Integrated Services Digital Network
ITV	Interactive television
kbps	Kilobits per second
LAN	Local area network
LEARN	Local Educational Administrative Requirements Network

MB	Megabytes
Mbps	Megabits per second
MIDI	Musical Instrument Digital Interface
MM	Multimedia
MPEG	Moving Pictures Experts Group
NET	Internet
NPV	Net present value
NTU	National Technological University
OMB	Office of Management and Budget
PC	Personal computer
ROI	Return on investment
SAI	Strategic Alignment Implementation
SAT	Systematic Approach to Training
SCVTS	Switched compressed video teleconferencing services
SIM	Strategic information management
SMART	System Management for Annual Requested Training
TQP	Technical Qualifications Program
TRADE	Training Resources and Data Exchange
TSL	Technology-supported learning
VSAT	Very small aperture terminal
WAN	Wide area network
WWW	World Wide Web

Glossary

ADVANCED TRAINING TECHNOLOGIES (ATT). Technologies (such as audio and video conferencing, multimedia, and the Internet) that can be utilized to facilitate the development and delivery of training to individuals at geographically separated locations.

ANALOG. Information represented by a continuous electromagnetic wave encoded so that its power varies continuously with the power of a signal received from a sound or light source.

ANALYSIS OF BENEFITS AND COSTS (ABC). A systematic approach for comparing alternative ways to satisfy an objective. The ABC provides a structured framework for collecting, analyzing, displaying, and communicating pertinent information to the decision making process.

ANTENNA. The device that sends or receives signals (electromagnetic) from the satellite. Also called a *dish*.

AUDIO TELECONFERENCE. Two-way audio only communication between two or more groups, or three or more individuals in separate locations.

BANDWIDTH. Determines the rate at which information can be transmitted across a medium. The rates are measured in bits (bps), kilobits (kbps), megabits (Mbps), or gigabits per second (Gbps). Typical transmission services are 64 kbps, 1.544 Mbps (T1) and 45 Mbps (T3).

BASELINE. A point of reference that can be compared to future progress.

BENCHMARKING. The process of continuously comparing an organization with the "Best in Class" to gain information that will help the organization take action to improve its performance. Benchmarking is a scientific method for identifying the best practices in a certain area and measuring an organization's processes against these practices to identify areas for improvement.

BENEFIT/COST RATIO (BCR). The present value of benefits divided by the present value of costs. The BCR provides a measure of the benefits obtained per dollar spent and is expressed as a decimal number. The benefit/cost ratio is a relative measure of an alternative's value.

BROADBAND. Communications channels that are capable of carrying a wide range of frequencies. Broadcast television, cable television, microwave, and satellite are examples of broadband technologies. These technologies are capable of carrying a great deal of information in a short amount of time, but are more expensive to use than technologies like telephone that require less bandwidth.

BROADBAND NETWORK. A local area network residing on coaxial cable capable of transporting multiple data, voice, and video channels.

BUSINESS CASE. A projection over the life of a program (or system) of the associated costs and benefits. It is typically used to determine the economic feasibility and cost effectiveness of a project, compare the present system (status quo) to a proposed change or enhancement, and predict the payback point and return on investment.

BUSINESS MODEL. A repository of meta data about an organization, which stores information pertaining to business functional areas, business processes, information systems, and information needs, and also stores the relationships between and among this information.

BUSINESS PROCESS. A sequence of logically related tasks that take an input, add value to it, and provide an output to an internal or external customer. The work activities that produce products or services (i.e., create value for the customer) including the efforts of people and equipment.

CABLE/CABLE TELEVISION. A broadband communications technology in which multiple television channels as well as audio and data signals are transmitted either one way or bidirectionally through a distribution system to single or multiple specified locations. Uses coaxial cable to transmit programs.

C-BAND. A category of satellite signals that transmit from earth at 4.0 to 6.0 gigahertz (GHz) and receive from the satellite at between 3.7 and 4.2 GHz, which are also shared with terrestrial line-of-sight microwave users. This band of transmissions has less path loss than the other standard used for satellites (Ku-band), but must have a large antenna for the same receiver input power level due to its use of longer wavelength frequencies.

CHANNEL. Paths over which Musical Instrument Digital Interface (MIDI) information travels. MIDI can send data on as many as 16 channels with a single MIDI cable.

COMPACT DISC. Plastic platter 4.72 inches wide that stores digital data or music, encoded and read by laser beam. Sometimes called *optical discs*.

COMPACT DISC-READ ONLY MEMORY (CD-ROM). Prerecorded, non-erasable disc that stores over 650 megabytes (MB) of digital data. The storage capacity of the CD-ROM varies.

COMPUTER-BASED TRAINING (CBT). Multimedia courses delivered online via a standalone computer workstation. The most advanced CBT allows learners to interact with the computer; the most basic form acts as electronic page turners.

COMPRESSED VIDEO. A reduced video signal output level that is used to reduce transmission requirements and associated costs. Transmits changes from one frame to the next which reduces the bandwidth to send them over a telecommunications channel. Also called *bandwidth compression, data compression, or bit rate reduction*.

COMPRESSION. Reduction of a signal's output level in relation to its input level to reduce storage requirements.

CORPORATE APPROACH. An approach involving the identification of common education and training needs across the Department (cross-cutting), and the collaboration of organizations (including the pooling of funds and other resources) to provide education and training opportunities that are applicable and accessible to more than one organization within the Department. The corporate approach takes full advantage of the enclaves of expertise that exist throughout the Department.

COST. The fixed and recurring costs associated with executing a process or providing a service (i.e., labor, materials, technology).

COURSEWARE. Software used in teaching. Often used to describe computer programs designed for the classroom.

CROSS-CUTTING. Education and training needs or courses that are shared and are mostly equivalent for several program, field offices, and laboratories within the DOE complex. It may be useful for each program/office or facility to add to or modify generic information to make it more site-specific. Mandated Environment Safety and Health training is an example of cross-cutting.

DEVELOPMENT. Development is most often used to denote "soft" interpersonal skills development or career/management development opportunities (only some of which are formal courses).

DIGITAL. Data stored in bits and bytes on a computer. It can be manipulated and displayed on a computer screen.

DISC. A storage medium for digital data usually in the form of a video disc or compact disc. Video discs and other optical storage media are referred to as *discs* (with a "c"). Computer diskettes are electromagnetic and referred to as *disks* (with a "k").

DISTANCE EDUCATION. Teaching and learning environment in which the instructor and the student(s) are geographically separated, and a combination of electronic media and print materials are used for instructional delivery. Distance Education includes distance teaching--the instructor's role in the process; and distance learning--the student's role in the process. Called *Technology-Supported Learning* in this business case.

DISTANCE LEARNING. The student's role in the process of distance education. Takes advantage of a wide range of technologies, such as interactive television, computer-based training, and Internet.

DOWNLINK. Transmission of radio frequency signals from a satellite to an earth station. A satellite receiving station.

EDUCATION. The learning experiences associated with the completion of a pre-established curriculum in order to gain a general body of knowledge that can be applied to a career. Education is frequently characterized as having broader, somewhat more global objectives of preparing a person to be a productive citizen or employee.

ELECTRONIC MAIL (E-mail). Mail or communications sent and received through electronic, nonpaper methods. Usually an mainframe, a local area network, or a bulletin board system is the transmission medium.

ETHERNET. Network communications standard developed by Xerox. Data transmission speed is typically 10 megabits per second.

FACILITATOR. (1) In adult education (androgogy), the individual who acts as a guide and resource to the students. (2) During the use of advanced training technologies, the individual responsible for the local component of a video teleconference site.

FIBER OPTICS. Communications medium based on a laser transmission that uses a glass or plastic fiber which carries light to transmit video, audio, or data signals. Each fiber can carry from 90 to 150 megabits of digital information per second or 1,000 voice channels. Transmission can be simplex (one-way) or duplex (two-way) voice, data, and video service.

FIBER OPTIC CABLE. Cable that contains a fine strand of glass-like material. Light, not electricity, is conducted through the cable.

FULL-MOTION VIDEO. A video signal output level that is not compressed. Video frames are displayed at 30 frames per second.

FULLY INTERACTIVE AUDIO/VIDEO. Two or more video conferencing sites can interact with one another via audio and video signals. Two sites may be fully interactive without necessarily being full-motion sites.

GROUPWARE. An interactive collaboration of workers or students via networked applications on the computer. It provides audio, video, and data sharing among a group of users using the network at the same time. Examples of programs/equipment that foster the concept of groupware is CLI's Cameo, Northern Telecom's Visit, and IBM's Person-to-Person.

HYPERMEDIA. Delivery of information through multiple connected pathways. Hypermedia allows users to branch seamlessly between text, graphics, audio, or video.

INTEGRATED SERVICES DIGITAL NETWORK (ISDN). A set of standards that provide a common architecture for the development and deployment of digitally integrated communications services. A set of standardized customer interfaces and signaling protocols for delivering digital circuit-switched voice/data and packet-switched data services.

INTERACTIVE MULTIMEDIA. A multi-level multimedia presentation that allows the user to access information randomly and nonsequentially.

INTERACTIVE TELEVISION (ITV). One of the most common forms of technology-supported learning. The instructor and student are physically separated, but connected through video, audio, and sometimes data links.

INTERACTIVE VIDEO. The capability to transmit and receive two-way video transmissions between two or more sites.

INTERNET. A worldwide connection of individual computer networks. The roots of the Internet lie in a collection of computer networks that were developed in the 1970s under the sponsorship of the United States Department of Defense. There is no surcharge to use Internet. Plans are in place to rename the Internet as the National Research and Education Network.

Ku-BAND. A category of satellite transmissions higher in frequency than C-Band, which are being transmitted from satellites placed in a geostationary orbit. The Ku-Band includes the microwave frequencies from 12 to 18 GHz and the band of satellite downlink frequencies from 11.7 to 12.2 GHz.

LEARNING ACTIVITIES. (1) The specific presentation materials, examples, practice exercises, simulations, group discussions, etc. associated with specific learning objectives, which are typically described in lesson plans. (2) All general methods that support learning. Formal instruction, mentoring, on-the-job training, and simulator-based training are examples of high-level learning activities.

LEARNING CENTER. An area equipped with multimedia workstations and other advanced training technologies that is designated for the performance of learning activities. Also called *training center*.

LINK. Connection from one place or medium to another. For example, buttons contain the linking information between cards in hypermedia.

LOCAL AREA NETWORK (LAN). Interlinked microcomputer system, the dimensions of which are usually less than 2 miles. Transmission rates are usually above 1 megabit per second.

MICROWAVE. That portion of the electromagnetic spectrum from approximately 1,000 MHz to 100,000 MHz. Due to its short wavelength characteristics, microwave energy is capable of being focused in a concentrated beam in specific directions and sent over long distances.

MULTIMEDIA. The integration of two or more media with a personal computer. The media list includes audio, video, text, graphics, and animation. The latest technologies even add scents.

NEEDS ASSESSMENT. The process of identifying customers; gathering and analyzing customer training and technology requirements; and determining customer-required levels of service, and training and technology needs for the short and long terms.

NET PRESENT VALUE (NPV). A dollar amount calculated by subtracting the total present value cost from the total present value benefit of the alternative. The higher an alternative's positive NPV, the more its benefits exceed its costs.

NON-CORPORATE APPROACH. An approach to education and training in which organizations make decisions about and fund education and training for their personnel without taking full advantage of the courses and resources available from other organizations in the Department. In a non-corporate environment each organization is acting independently with minimal sharing of resources and information.

ONE-WAY VIDEO, TWO-WAY AUDIO. People at the originating location can be seen and heard by participants at other locations. The people at the originating location can hear, but cannot see participants at other locations.

PARTNERING. A long-term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources.

PERFORMANCE MEASURES. The information used to measure the effectiveness of the process execution.

POINT-TO-MULTIPOINT. A teleconference broadcast from one location to several receiving locations.

POINT-TO-POINT. A teleconference broadcast between two locations.

RECEIVE SITE. The site receiving the transmission from the origination site. A video teleconference might have 100 or more receive sites. Also known as *downlink sites*.

RETURN ON INVESTMENT (ROI). In this business case, a dollar amount equal to the net benefit of an alternative. ROI for each alternative was calculated by taking the difference between the total benefits and the total costs over the 5-year analysis period. Also expressed as a percentage.

SATELLITE. An electronic retransmission device serving as repeater in a geostationary orbit around the earth for the purpose of receiving and retransmitting electromagnetic signals. It normally receives signals from a single source and retransmits them over a wide geographic area.

SLIDE SHOW (Electronic). Computer screens designed in a sequence for projection purposes. Many hypermedia programs provide transitional effects for these sequences (such as dissolves or wipes).

T1. High-speed digital data channel/carrier with a bit rate of 1.544 Mbps, which requires a bandwidth of approximately 2.1616 MHz to transmit a television-type cable environment. Each T1 circuit can accommodate 24 voice channels.

T3. A carrier of 45 Mbps bandwidth. One T3 channel can carry 28 T1 channels. Used for point-to-point digital video transmissions or for major PBX-PBX interconnection. Dedicated service delivered via fiber optic cable.

TECHNOLOGY-SUPPORTED LEARNING (TSL). An approach to using advanced training technologies as delivery methods for cross-cutting education and training learning activities. Also called *Distance Education*.

TELECONFERENCE. Electronic communications between two or more groups, or three or more individuals, in separate locations via audio, audio graphics, video, or computer.

TRAINING. Learning situations in which specific objectives can be readily identified. Training helps fit a person for a particular job in a particular system and may be very procedural in nature.

TWO-WAY VIDEO, TWO-WAY AUDIO. People at the originating location can be seen and heard by participants at other locations. The people at the originating location can hear and see participants at other locations. Usually limited to point-to-point communication.

UPLINK. Transmission of radio frequency signals from an earth station to a satellite.

VIDEO. The bandwidth and spectrum of the signal that results from television scanning and is used to reproduce a picture.

VIDEO TELECONFERENCE. A meeting involving at least one uplink and a number of downlinks at different locations. Electronic voice and video communication between two or more locations. The teleconference can be fully interactive voice and video or two-way video. It may involve full-motion, compressed, or freeze-frame video.

WORKSTATION. An integrated set of components, consisting of a computer and peripherals, used to deliver education and training learning activities or to provide a computer work area.

WORLD WIDE WEB (WWW). A networked, information delivery system that presents information in hypermedia-based format. The World Wide Web displays pages of information with links to other pages, images, video clips, and sound clips.

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Appendix J

Data Supporting the Analysis of Benefits and Costs

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Appendix J. Data Supporting Analysis of Benefits and Costs

Table J-1. Compression of Course Length

<p>Compression of course length due to conversion to a technology-supported learning delivery method (compression expressed as percentage of previous classroom delivery time). Example: 75% compression means previous 8-hour course when converted takes 6 hours; 25% compression means previous 8-hour course converted to 2 hours.</p>			
Item	Delivery Method	Compression Data	Source
1	ITV	FAA reported 75% compression	Federal Aviation Administration (FAA), Operations Research Service, <i>Cost-Benefit Analysis of Implementing Distance Learning (MNS #124)</i> , section 2.2, April 1994
2	ITV	FAA cited industry studies showing as much as a 50% compression	Federal Aviation Administration, <i>Course Developer's Guide for Video Teletraining</i> as cited in the Social Security Administration publication, <i>Interactive Distance Learning: Recommendations for Training Delivery</i> , draft, April 1995
3	ITV	Hewlett Packard reported 50% reduction in classroom hours	Letter from Dave Lewis, Hewlett Packard Video & Broadcast Services, to Patrick S. Portway, Executive Director, United States Distance Learning Association, July 1996.
4	ITV	Training academy reported 50% to 75% compression	Data provided by the Department of Energy, Safeguards and Security Central Training Academy, Albuquerque, New Mexico

Table J-1. Compression of Course Length

Item	Delivery Method	Compression Data	Source
5	various	Author cited three studies from 1990-1994 indicating 30-40% reduction in classroom instruction time	Larry D. Moulds, Ph.D., <i>Using Distance Learning in the Training of Adult Learners</i> , ED Journal, Volume 10#6, United States Distance Learning Association, June 1996
6	CBT	Organizations interviewed cited the following compression rates: Arthur Andersen and Company: 57% Apple Computer: 13% DOE/Westinghouse Hanford: 15%	Based on an informal telephone survey conducted by the Center for Performance Improvement, Idaho National Engineering Laboratory, Lockheed Martin Idaho Technologies, 1995
7	CBT	Results of 6 studies indicate overall average 35% to 40% reduction in course length: Fletcher (40 samples): 31% average Adams (6 controlled samples): 38%-70% Union Pacific (2 courses): 35%-50% Bradley (30 samples): 50% Kulik (>100 samples): 30% Hall (>100 samples): 20%-80% with 40%-60% most common	Rex J. Allen, <i>Step Right Up! Real Results for Real People</i> , Computer-based, Multimedia Training Can Make a Big Difference, If It Is Done Right, Allen Communications, 1997. Internet publication at http://www.allencom.com

Table J-2. Hours Expended and Cost for Conversion from Existing Training

<p>Cost for conversion from existing training is based on conversion to one hour of delivered training. Hour estimates are based on the hours expended on the development of one hour of delivered training.</p>			
Item	Delivery Method	Cost Data	Source
1	ITV	Average cost of \$14,900 per delivered hour of training	Data provided by the Department of Energy, Safeguards and Security Central Training Academy, Albuquerque, New Mexico
2	ITV	Average cost of less than \$3,000 per delivered hour of training	Estimate provided by Ed Kovac of Vertex Solutions, Inc. based on experience with the Federal Aviation Administration.
3	CBT	Cost estimate of \$25,000 per delivered hour of training based on 200-250 hours expended to develop one hour of delivered training	Rex J. Allen, <i>Step Right Up! Real Results for Real People</i> , Computer-based, Multimedia Training Can Make a Big Difference, If It Is Done Right, Allen Communications, 1997. Internet publication at http://www.allencom.com
4	CBT	<p>Range of hours from less than 100 to more than 800 depending on course complexity</p> <p>Type 0 - Hypertext: less than 100 hours Type I - Interactive Hypermedia: 100-300 hours Type II - Interactive Multimedia: 200-500 hours Type III - Simulation: 400-800 hours</p>	V. Eugenio and E Habalow, "Is All Multimedia Created Equal? Differentiating Between Four Types of Multimedia Products," <i>Journal of Instruction Delivery Systems</i> , Winter 1994.

Table J-2. Hours Expended and Cost for Conversion from Existing Training

Item	Delivery Method	Cost Data	Source
5	CBT	Organizations interviewed cited the following estimates: Arthur Andersen and Company: \$70,000-150,000 Apple Computer: \$6,000-48,000 DOE/Westinghouse Hanford: \$7,500 Nuclear Regulatory Commission: \$31,000 DOE/Savannah River: \$15,000 without video \$80,000-90,000 with video	Based on an informal telephone survey conducted by the Center for Performance Improvement, Idaho National Engineering Laboratory, Lockheed Martin Idaho Technologies, 1995

Table J-3. Cost for Training Related Travel

Item	Cost Data	Source
1	\$1000 per trip (\$500 airfare, \$100 per day per diem, 5 days)	Rex J. Allen, <i>Step Right Up! Real Results for Real People</i> , Computer-based, Multimedia Training Can Make a Big Difference, If It Is Done Right, Allen Communications, 1997. Internet publication at http://www.allencom.com
2	\$1,500 per trip	Data provided by the Department of Energy, Safeguards and Security Central Training Academy, Albuquerque, New Mexico